Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

APRIL, 1958

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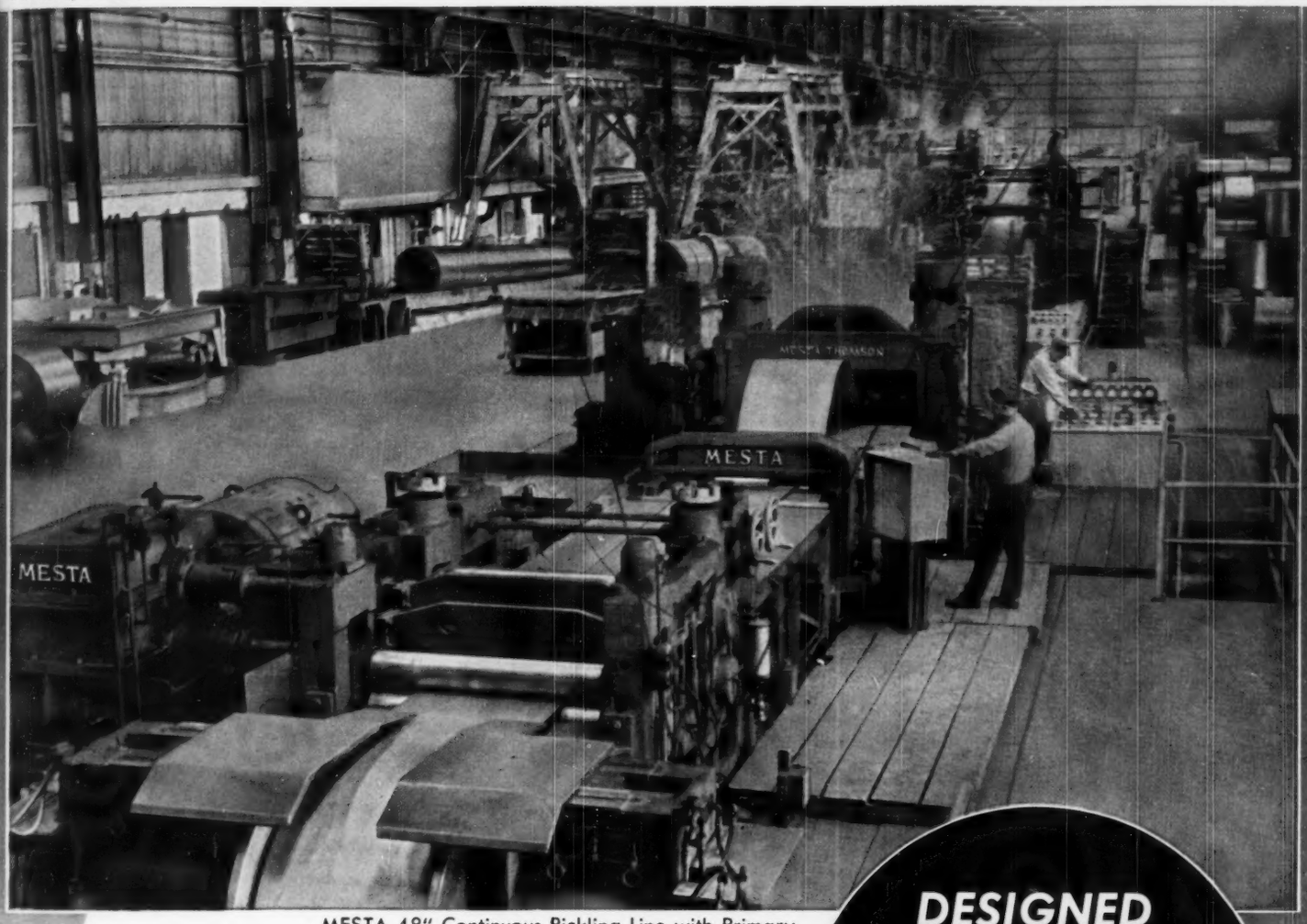
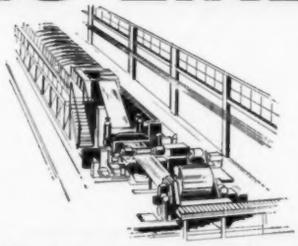


MESTA 48" Continuous Pickling Line with Primary and Secondary Processors, Flash Welder, Up-Cut Shears, Side Trimmer and Up-Coiler.

DESIGNED AND BUILT BY MESTA

Continuous PICKLING LINES



Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

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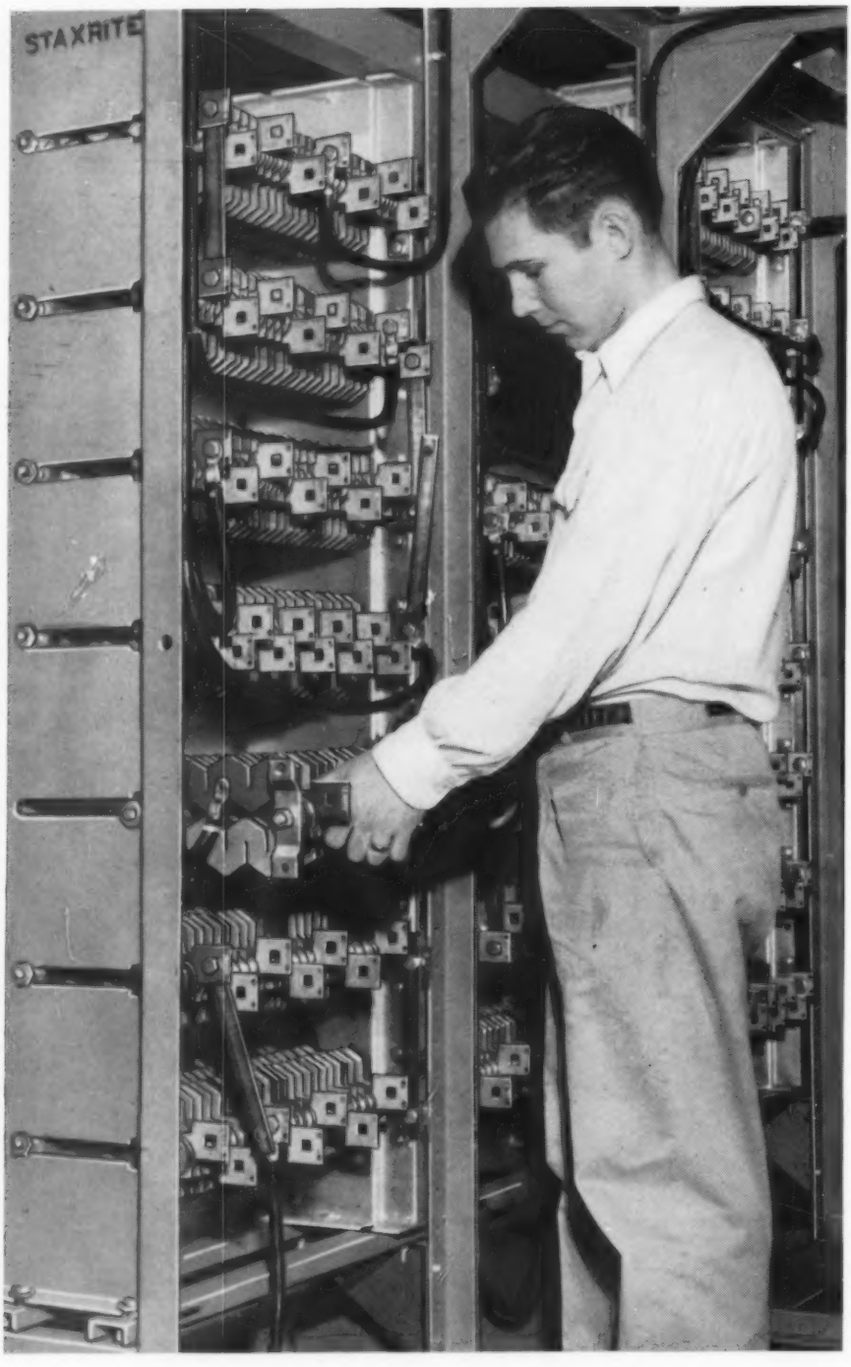
DETROIT

Complete non-breakable resistor banks . . .
factory assembled, wired and ready to go

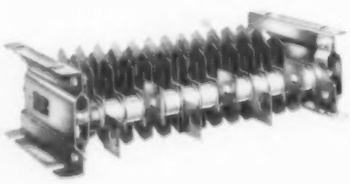


Here is the very latest word in Mill Duty resistors . . . Cutler-Hammer's "draw-out" designed non-breakable mill duty resistors and Staxrite®, the multiple resistor mounting frame. Together these two units become a solid free-standing resistor bank that can be "custom-tailored" to meet your specific needs. Cutler-Hammer's Staxrite resistor frames, available in graduated sizes, will accommodate up to nine non-breakable resistor units. Add to this the optional feature of a terminal board and grid-to-terminal wiring and your resistor bank is ready for rapid installation. No more time consuming box-to-box mounting. Costly on-the-job wiring is cut to a bare minimum. A Staxrite resistor bank saves valuable space too . . . it only requires the floor area of a single resistor box. Notice how easily the "draw-out" designed resistor units slide in and out of position; this is a Cutler-Hammer exclusive. Each resistor unit is completely independent, and can be serviced or replaced by a spare unit without disturbing end frames, adjacent resistor units, or mounting members. "Draw-out" design will cut your "down-time" during maintenance and alterations. Enclosed resistor banks also available . . . added safety for your men and protection for the resistors. For complete information, write or wire today.

CUTLER-HAMMER Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin.
Associate: Canadian Cutler-Hammer, Ltd., Toronto.

CUTLER-HAMMER
MOTOR CONTROL
C-H

Cutler-Hammer's Non-breakable Mill Duty Resistors are the choice of Mill engineers everywhere



These extra rugged resistors were designed specifically for mill and crane applications where service is severe. Cutler-Hammer 11011 Mill Duty resistors are available in three standard widths and can be mounted independently or in a Staxrite mounting frame. Check these other important features of design and construction.

- Stamped chrome-steel grids
- Shock-proof
- Vibration-proof
- Corrosion-resistant
- Welded grid joints
- No pressure dependent grid contacts
- Staggered, projected terminals
- Welded grid-to-terminal joints
- Heavy duty mica insulators

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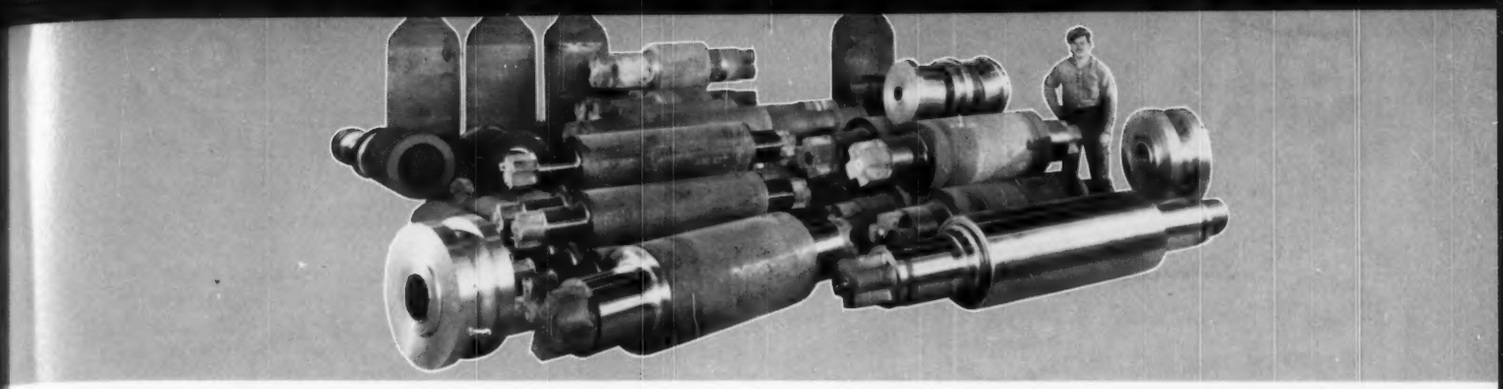
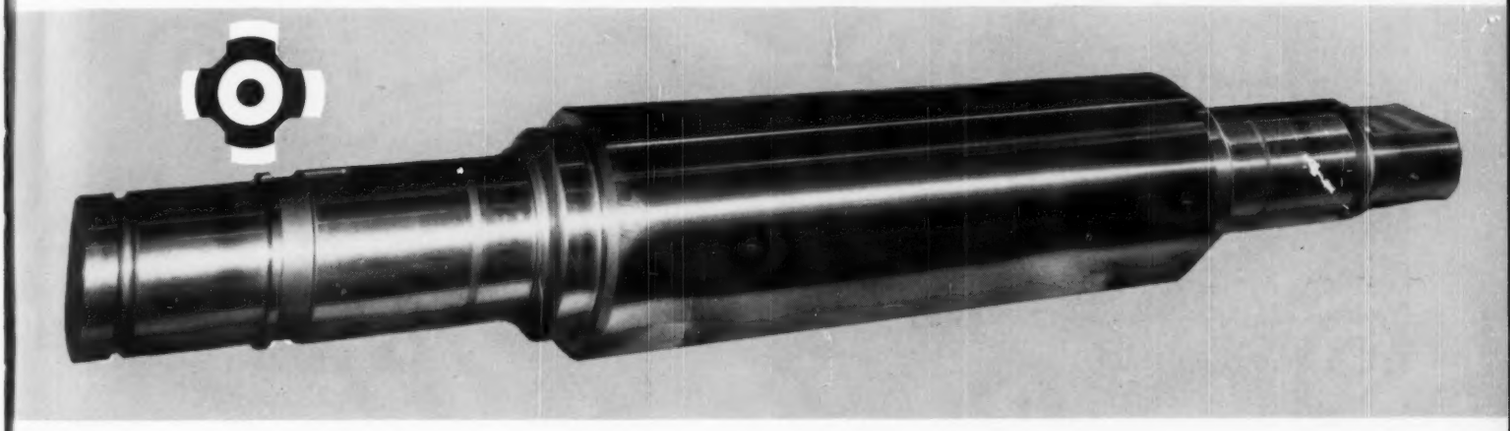


MAGALOY (nodular iron) ROLLS

FROM 7" TO 42-1/2" DIAMETER



TYPICAL APPLICATIONS

MAGALOY GRADE "A"
(Sclerescope Hardness 30-38)
Piercing Mills

MAGALOY GRADE "B"
(Sclerescope Hardness 45-55)
Blooming Mills • Bar & Billet Mills–Roughers
Rod Mills–Roughers • Plug Mills (5½" and over)
Skelp Mills • Hot Sheet Bounce Mills

MAGALOY GRADE "C"
(Sclerescope Hardness 58-65)
Merchant Mills–Leaders and Finishers
Rod Mills–Intermediate Train • Hot Strip Mills
Cont. Bar & Billet Mills–Intermediate & Finishers
Plug Mills (up to 5½")
Tube Mills–Forming & Welding, Sizing, Reelers
Straightening • Skelp Mills • Edging Mills

MAGALOY GRADE "D"
(Sclerescope Hardness 66-70)
For applications requiring higher-than-average strength and hardness penetration.

• MUCH LESS BREAKAGE • BETTER SURFACE ON ROLLED MATERIAL • LOWER COST PER TON ROLLED • WEARING QUALITY OF GRAIN ROLLS • PHYSICALS EQUAL TO CAST STEEL • UNIFORM HARDNESS PENETRATION • SUPERIOR MACHINING PROPERTIES

A SPECIALIST AND A PIONEER IN NODULAR IRON

One of the first licensees (1951) for nodular iron, Aetna-Standard's foundry has built a reputation as a specialist in these rolls (trade name — Magaloy). In the making of nodular iron rolls, control of penetration is most important. So is the skill of the foundry to deliver the same uniformity of rolls order after order. As a pioneer and a specialist in nodular iron, Aetna's foundry has an excellent reputation among roll users and suppliers, particularly for penetration and uniformity of rolls.

AETNA • STANDARD

THE AETNA-STANDARD ENGINEERING COMPANY

GENERAL OFFICES: PITTSBURGH, PA. • PLANTS: ELLWOOD CITY, PA., WARREN, OHIO • RESEARCH LABORATORY: AKRON, OHIO

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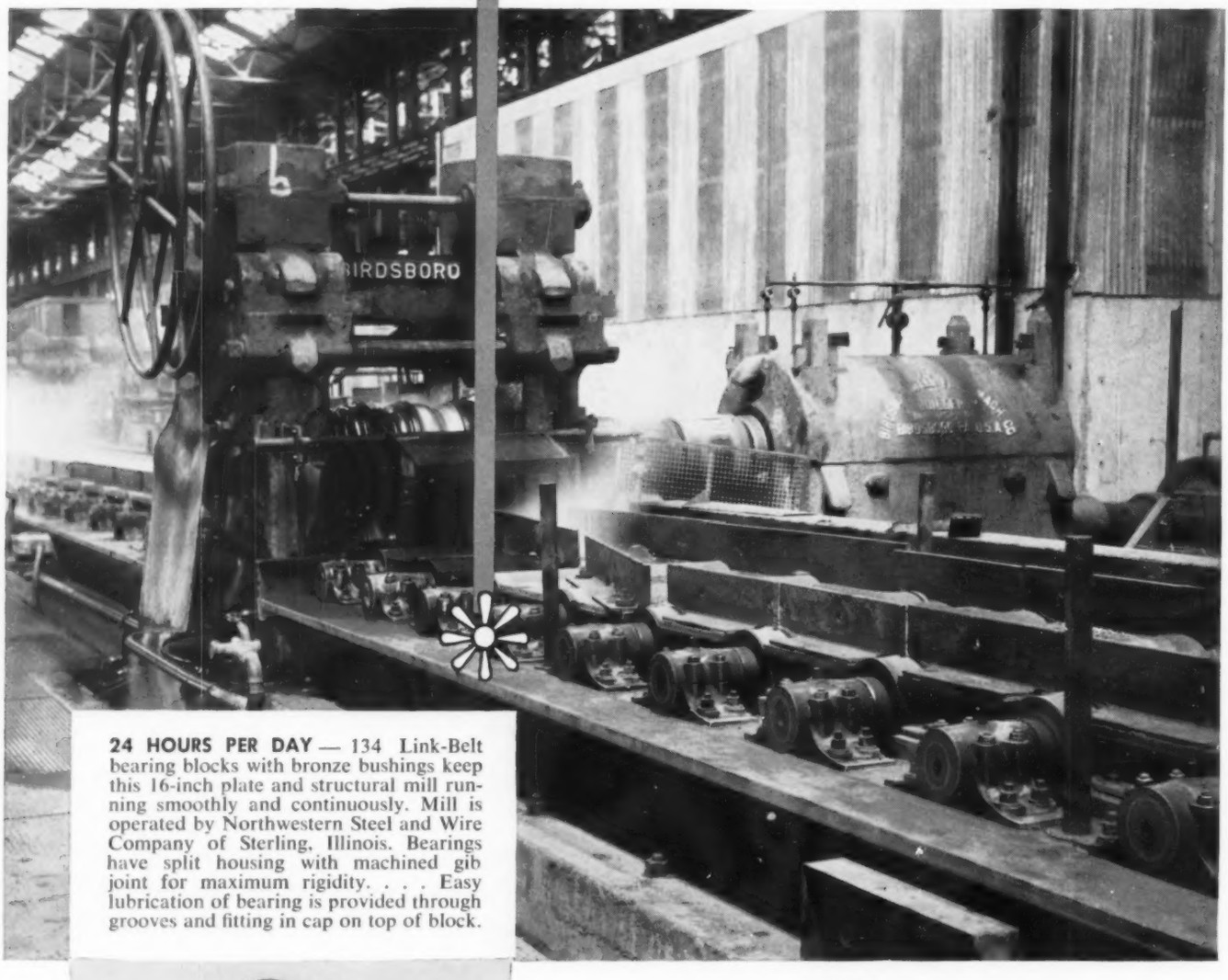
SPECIFY LINK-BELT BRONZE BEARINGS, available from local stocks

CONDITIONS of heavy bearing pressures, impact loads or heat conditions beyond the application limits of babbitt call for Link-Belt bronze bearings. Housings of durable cast gray iron or cast steel are light and compact, yet have the strength and rigidity necessary for heavy-duty operation. Firm seating on supports is assured by close-tolerance finishing from base to center of bore. Bores are also finish-machined for concentricity and accurate fit on the shaft.

And Link-Belt's complete range of solid, split, gibbed or angle blocks means that there's a Link-Belt bronze bearing for your application . . . available in stock for ½- to 8-inch shafts. Call your nearest Link-Belt office or authorized stock-carrying distributor. Refer to the yellow pages of your local telephone directory.



24 HOURS PER DAY — 134 Link-Belt bearing blocks with bronze bushings keep this 16-inch plate and structural mill running smoothly and continuously. Mill is operated by Northwestern Steel and Wire Company of Sterling, Illinois. Bearings have split housing with machined gib joint for maximum rigidity. . . . Easy lubrication of bearing is provided through grooves and fitting in cap on top of block.

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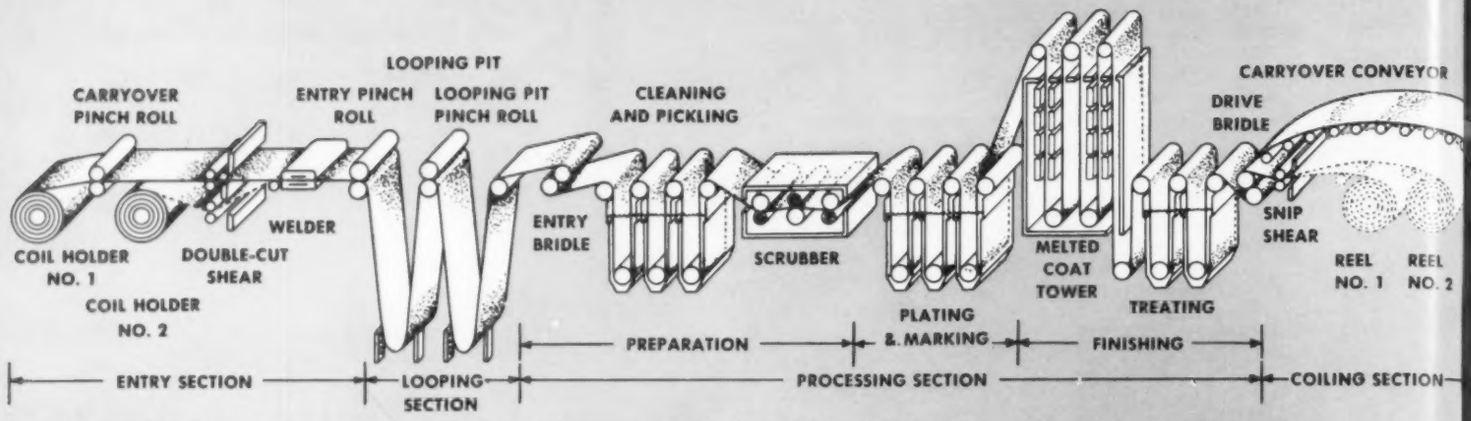
Over 80% of all FERROSTAN* TINNING LINES are CLARK



ENTRY SECTION. This section operates as an independent unit so it can be started and stopped while the rest of the line is running. Entire section can be accelerated to overspeed condition to replenish the loops. When loops are filled, speed is automatically reduced to match that of processing section.

LOOPING SECTION. Loops provide storage for strip during periods when entry section is stopped for coil changes, permitting processing section to run continuously. Multiple loops permit shallower looping pit, and can be synchronized to stay uniform. Modulated loop control provides stepless regulation of entry speed so strip is fed to processing section at constant speed.

PROCESSING SECTION. Plating, marking, melted coat and chemical treatment currents are accurately synchronized with line speed. Adjustable differential plating control can be provided to permit heavier tin plate deposit on one side of strip. Necessary torque and speed regulation is provided for individual motor drives on conductor, sink and deflector rolls. Overall line speed is accurately regulated by means of magnetic amplifiers.

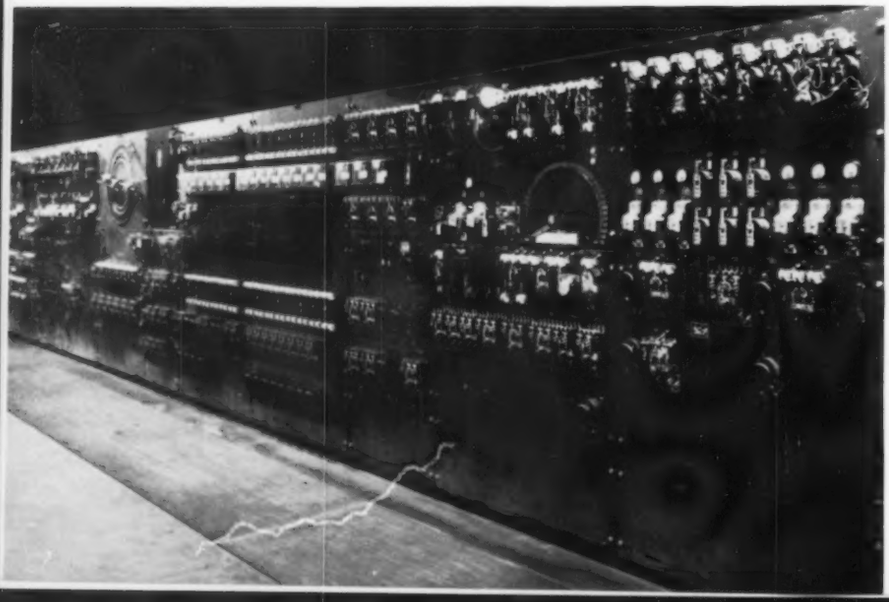
COILING SECTION. Line shown permits optional type operation, either coiling or shearing. When coiling, control transfers from one reel to the other while line is running. Carryover conveyor is used only when shearing.

Continuous electrolytic tinning lines represent just about the most complicated electrical control problems to be found in any manufacturing process. From coil holders at entry end to recoilers—or classifier and piler—at exit end, line speeds and tension must be precisely regulated and coordinated with processing operations. Only with the most carefully engineered control system can the line be operated continuously at high speeds to produce the high uniform quality tinned strip demanded by the canning industry —No. 1 consumer of tin plate.

The Clark Controller Company, with its more than 30 years experience in specialized engineered control, and with electrical control its sole interest, is the leader in supplying the elaborate and complicated controls required by Ferrostan* tinning lines.

Shown above is a flow diagram of a typical Ferrostan* line, indicating the essential components and the complexity of the control required. This line provides both shearing and piling of tinned strip, and coiling. A number of lines, originally designed for only shearing and piling have recently added coiling—with Clark engineering the supplementary control.

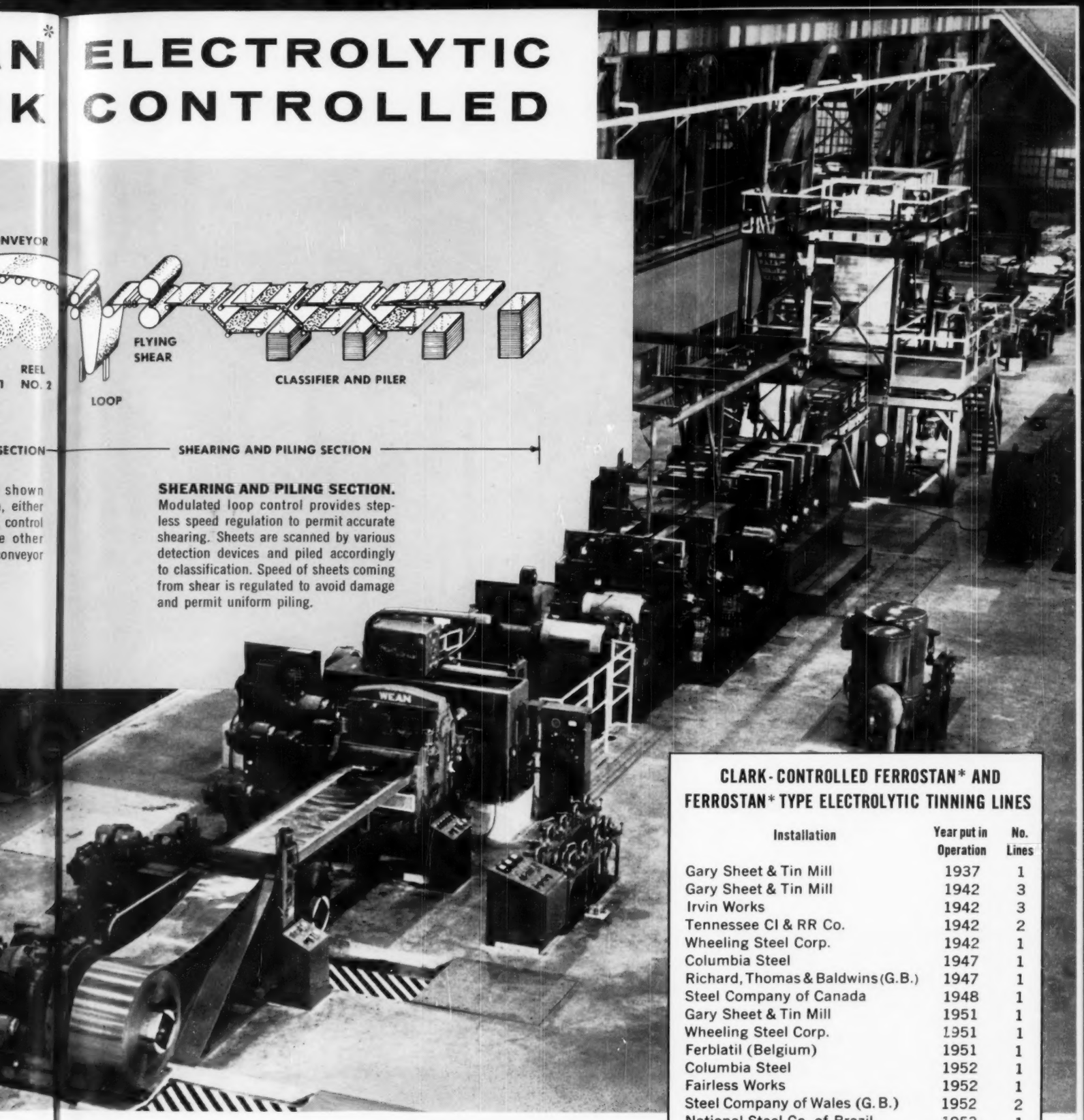
Photo Courtesy The Wean Engineering Company, Inc.



A portion of the main control panel for a Ferrostan* tinning line . . . In addition to tinning lines, Clark is a major supplier of essential control for all types of processing lines in the basic metal industries including rolling mills, pickling, slitting, shearing, annealing and galvanizing lines, as well as control for wire drawing, blast furnace charging, cranes and many other mill and material handling operations.

ELECTROLYTIC CONTROLLED

SHEARING AND PILING SECTION. Modulated loop control provides stepless speed regulation to permit accurate shearing. Sheets are scanned by various detection devices and piled accordingly to classification. Speed of sheets coming from shear is regulated to avoid damage and permit uniform piling.



Typical Ferrostan* electrolytic tinning line—completely equipped with Clark engineered control. Entry section in foreground shows coil holder, shear and welder. Looping pit is below floor level and not visible. Preparation and plating sections can be seen in front of melted-coat tower in upper right. Classifier and piler are in far background.

*Trade Mark - U. S. Steel Corp.

CLARK-CONTROLLED FERROSTAN* AND FERROSTAN* TYPE ELECTROLYTIC TINNING LINES

Installation	Year put in Operation	No. Lines
Gary Sheet & Tin Mill	1937	1
Gary Sheet & Tin Mill	1942	3
Irvin Works	1942	3
Tennessee CI & RR Co.	1942	2
Wheeling Steel Corp.	1942	1
Columbia Steel	1947	1
Richard, Thomas & Baldwins (G.B.)	1947	1
Steel Company of Canada	1948	1
Gary Sheet & Tin Mill	1951	1
Wheeling Steel Corp.	1951	1
Ferblatil (Belgium)	1951	1
Columbia Steel	1952	1
Fairless Works	1952	1
Steel Company of Wales (G.B.)	1952	2
National Steel Co. of Brazil	1953	1
Tennessee CI & RR Co.	1955	1
Toyo Kohan (Japan)	1955	1
Yawata (Japan)	1957	1
Altos Hornos de Mexico	1957	1
Cornigliano (Italy)	1957	1
Fuji (Japan)	*	1
Yawata (Japan)	*	1
Kaiser Steel Corp.	*	1
* Under Construction	TOTAL	29

The **CLARK CONTROLLER** *Company*

Everything Under Control

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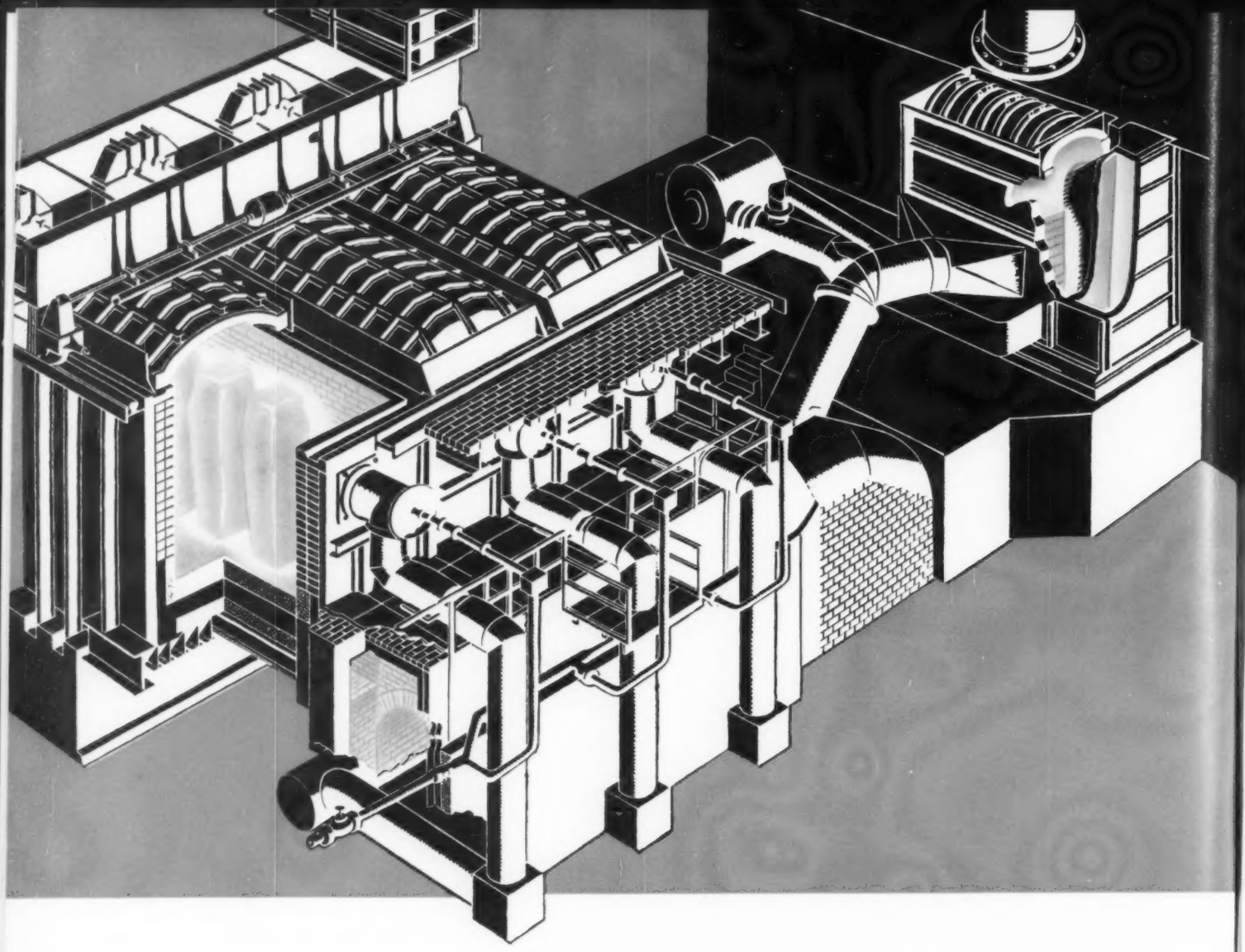
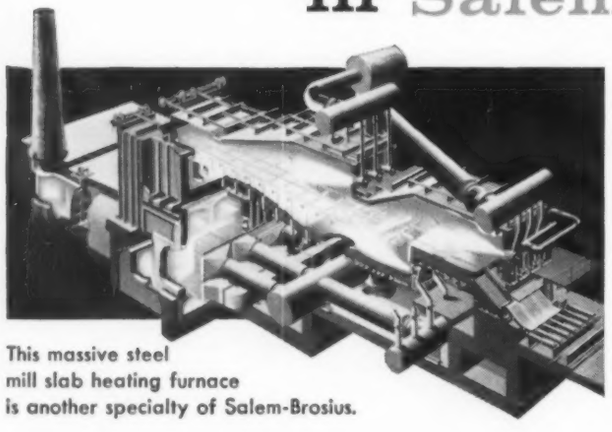


Ingot heating is fast and uniform in Salem-Brosius soaking pits



This massive steel mill slab heating furnace is another specialty of Salem-Brosius.

This battery of Salem-Brosius rectangular soaking pits currently is in round-the-clock operation heating ingots in a large steel mill. Of this installation, a top operating official said: "These pits are heating more steel ingots ready for rolling with less fuel consumption, less maintenance costs, and better temperature uniformity than any other type of pit in our plant."

Reports like this are typical, not only about these rectangular soaking pits, but all Salem-Brosius furnaces. Salem-Brosius engineers possess an enviable record for designing furnaces that produce maximum, high-quality output at minimum operating cost. If your plans call for soaking pits or any heating or heat-treating furnaces, send us an inquiry. There will be no obligation.

SALEM-BROSIUS, INC.

CARNEGIE, PENNSYLVANIA

In Canada: Salem Engineering Limited • 1525 Bloor Street West, Toronto 9, Ontario

SPECIAL MECHANICAL EQUIPMENT • INDUSTRIAL HEATING FURNACES • MATERIALS HANDLING EQUIPMENT

Unmasking a Myth* about OXYGEN

the Myth:

Reliability of oxygen supply is possible only through hauled-in liquid oxygen generated at remote central stations.

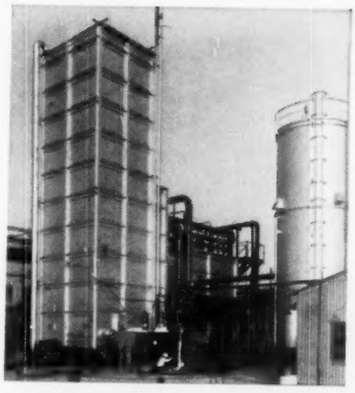
the Fact:

Operating records prove that Air Products on-site systems provide complete reliability.

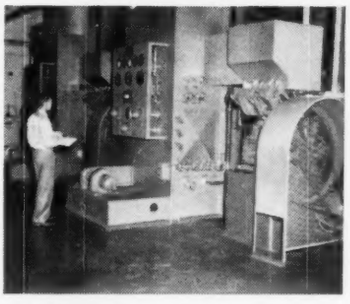
In 17 years, no Air Products customer has ever been without oxygen.

the Reasons:

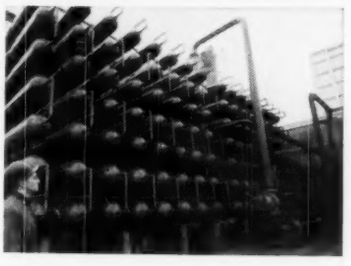
1. Single Air Products generators regularly operate one year without any shutdown whatsoever.



2. Multiple generator installations assure constant supply regardless of shutdowns for maintenance and defrosting.



3. Generator-fed storage systems — for both liquid and gas — provide instantly available reserves as positive insurance against *any* shutdown. These systems may be made independent even of outside power supplies... can contain many days' supply of oxygen.



Air Products has unmasked many myths about oxygen generation and use. For all your needs . . . oxygen, argon and hydrogen . . . Air Products offers reliable supply systems erected on your property or immediately adjacent, providing gas at a guaranteed cost, with no capital investment by the customer.

For the best answer to your gas supply needs, contact us at Allentown, Pa.

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*myth (mith), n. 1. A story, the origin of which is forgotten, ostensibly historical but usually such as to explain some practice, belief, institution, or natural phenomenon. (by permission from Webster's New Collegiate Dictionary © 1956, by G. & C. Merriam Co.)

Johns-Manville Insulating Fire B

put physical and thermal properties *in proper balance!*

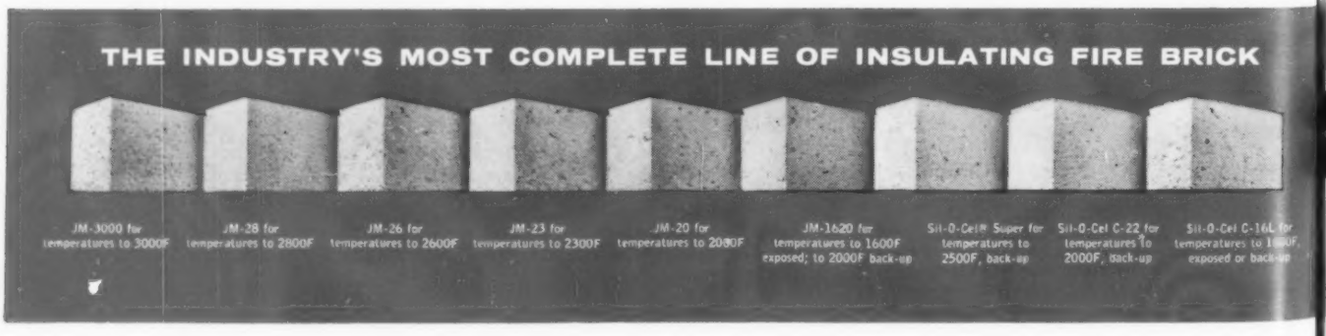
. . . provide essential high-temperature resistance and low conductivity . . . yet maintain high load-bearing strength with low spalling!

Only Johns-Manville's insulating fire brick family offers the right combination of properties to meet the diversified requirements of modern furnace construction.

Johns-Manville's nine different insulating fire brick mean you never have to settle for a brick that's nearly right! Instead you choose the one insulating fire brick or combination of brick that best meets your specific requirements for temperature resistance, load-bearing strength, conductivity and density.

Johns-Manville has two strategically located plants for the production of insulating fire brick: Lompoc, California and Zelienople, Pennsylvania. Insulating fire brick and other Refractory Products are available from the stocks of Authorized J-M distributors in key industrial areas.

For further information, call your nearest J-M representative. Or write for brochure IN-115A to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.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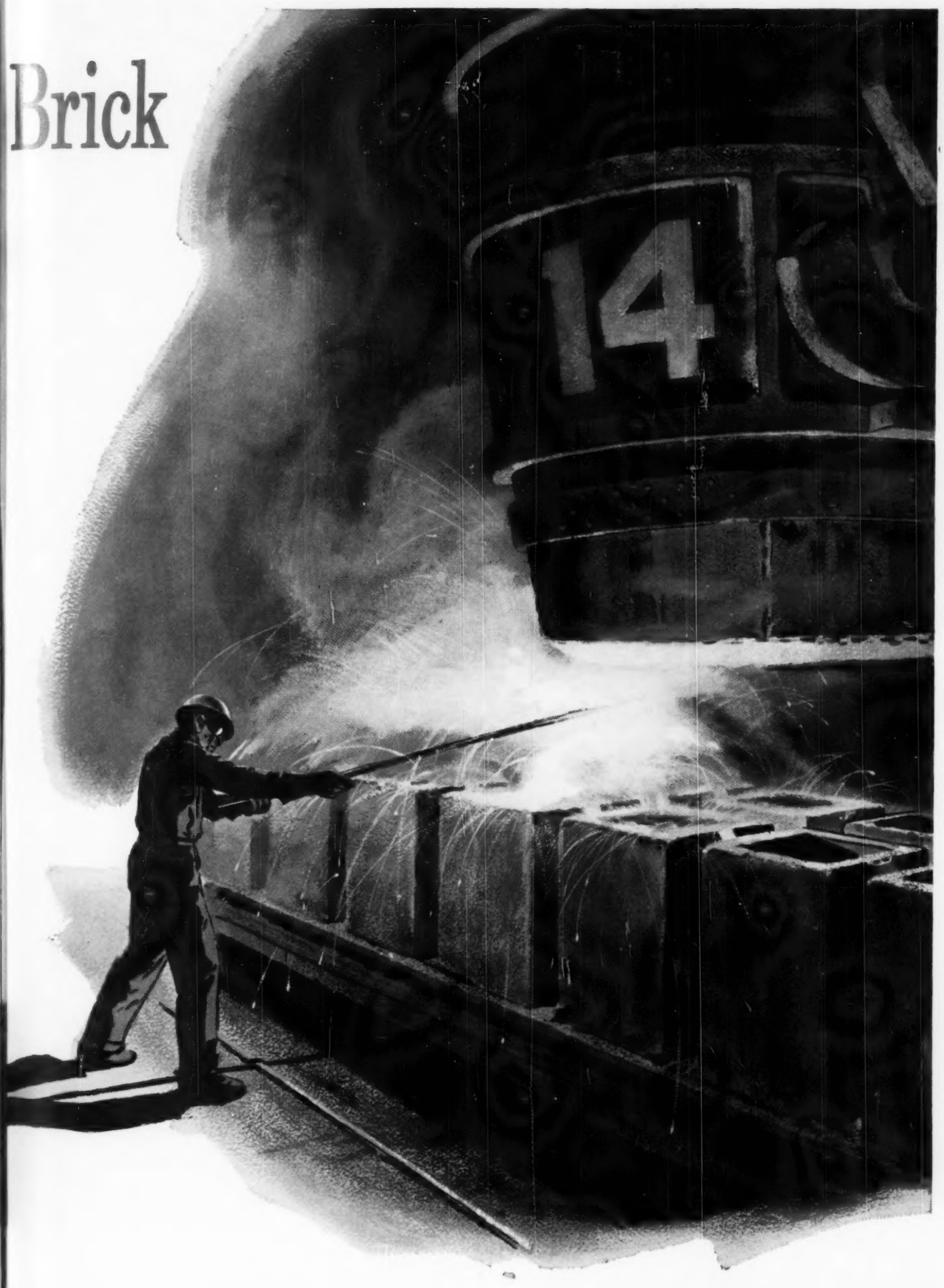
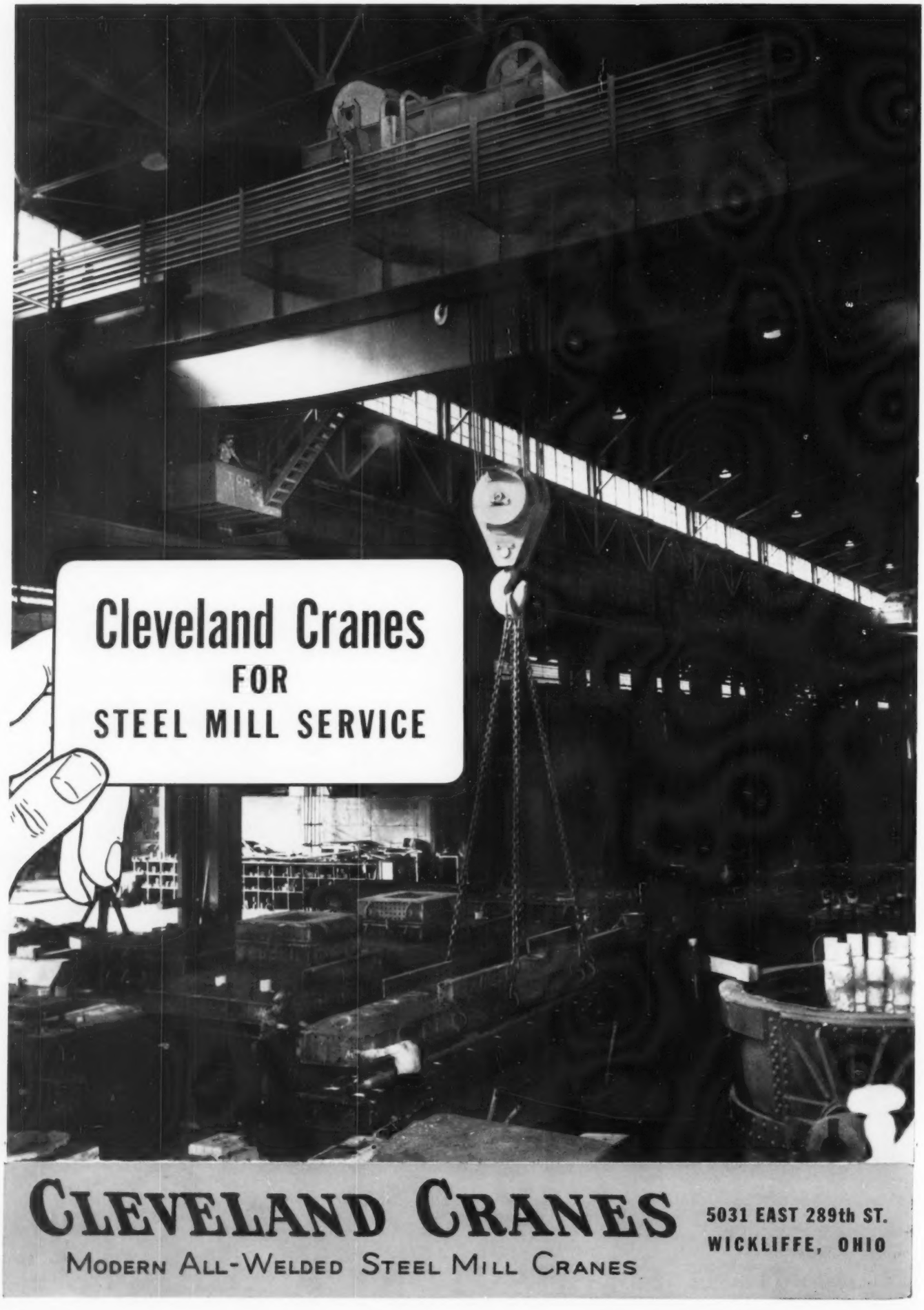
JM-28 for temperatures to 2800F
JM-26 for temperatures to 2600F
JM-23 for temperatures to 2300F
JM-20 for temperatures to 2000F
JM-1620 for temperatures to 1600F exposed; to 2000F back-up
Sil-O-Cel® Super for temperatures to 2500F, back-up
Sil-O-Cel C-22 for temperatures to 2000F, back-up
Sil-O-Cel C-16L for temperatures to 1600F, exposed or back-up

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville REFRACTORY and NS



NSULATING REFRACTORY PRODUCTS



CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

△ We have heard much about wages and profits in recent months. Union leaders say wages are too low and must be raised, and that inflation comes from high profits. Representatives of industry (steel, automobile, etc.) insist that profits are inadequate and prices must be raised, and that rising wage costs are the root of inflation.

Meanwhile, the nation's output of goods and services soared to $434,000,000,000 in 1957 and personal income totaled $343,000,000,000—both five per cent higher than in 1956. But only one-fifth of this increase was from physical growth. The other four-fifths came through higher prices.

Inflation is with us, but no one will admit being in any way responsible for it. Actually, labor and business have both contributed to it. Wages cannot go up faster than productivity without affecting prices, nor can profits. The biggest offender, however, is probably government policy which has permitted the supply of money and credit to triple in less than 20 years.

Too many people have been lulled into the belief that the merry-go-round could go on forever. A few years ago, a banker remarked: We know it's wrong, but it seems to be working."

Actually, inflation brings on a temporary prosperity only because we are, in effect, spending the purchasing power of the money we've laid aside for our old age. The harvest comes later.

The responsibility for inflation rests on the consciences of government, business and labor unions—and current news seems to indicate that it does not weigh too heavily on any of the three.

△ Some statistician figured out that if inflation proceeds in the next 50 years as it has in the past 50, a haircut and shave will cost $25.00.

△ A former manager of the Bank of Montreal, B. C. Gardner, put it very succinctly: "If we do less for a dollar, we can hardly complain if a dollar does less for us.

△ As increased spending plans foreshadow the end of the original $73,900,000,000 federal budget for fiscal 1959 and indicate a return to deficits (perhaps $10,000,000,000 or more), we shouldn't ignore the special funds outside of the budget, which amount to about $16,500,000,000 a year. These include social security, highways, etc., and represent an additional "take" from your pocketbook and mine.

△ This wonderful standard of living we hear about sounds so good it's a shame we can't afford it.

△ At the Brussels World Fair, the pavilion of the European Coal and Iron Community will exhibit a detailed model of an integrated steel plant. Built to a 1:30 scale, the model is almost 200 ft long and covers an area of about 785 sq ft. It is based on a plant of 2,000,000 tons annual capacity and represents coal and ore mines, coke plant, sintering plant, blast furnace, power station, open hearth and electric furnaces, converters, rolling mills and transportation equipment. Most of the units can be set in motion by pushbutton or lever.

△ Do you remember . . .
. . . when it was always the boy who asked for dates?
. . . when there were no kiss-proof lipsticks, but most of the girls were?
. . . when kids were juvenile delinquents but didn't know it?
. . . when Franklin D. Roosevelt, campaigning for the presidency, criticized President Hoover's $4,600,000,000 budget as excessive?
. . . when you could get a car repaired about as cheaply as you can park one now?

If you can, you're about ready for social security.

△ American automobile manufacturers have apparently seen the light and are planning to produce small cars, to sell at $1600 to $1800. That's fine. Now we hope they'll soon recognize that a lot of people would like *good*, small cars—something selling between $3000 and $4000 that won't be burdened down with fins, a multiplicity of lights, etc., and that will fit into 10-year old garages.

△ We don't know what villain started this "do-it-yourself" craze, but we're willing to give a medal to someone who'll put out good instructions on "how to get out of doing it yourself."

△ From Typo Graphic:

"They're packed with outlaws,
Thieves and crooks,
And yet we call them
Comic books."

△ The William Feather Magazine has been gathering names of men who have used their original Gillette for 30 or more years. One man claimed 50 years. That reminds us that our own Gillette, in constant use for 38 years, does a better job than any of the later models. Just goes to show that modern conveniences aren't always improvements.

△ A coal research center will be built at Monroeville, Pa., a suburb of Pittsburgh. It will be operated by Bituminous Coal Research, Inc., and will combine the present laboratory at Columbus, Ohio, the laboratory and administrative headquarters now in the Oakland section of Pittsburgh, and the fiscal offices now in Washington, D.C. The new center will be financed primarily by funds from the coal industry and from Pittsburgh industrial companies. Completion is expected in 1959.

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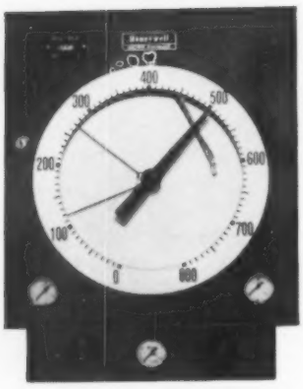

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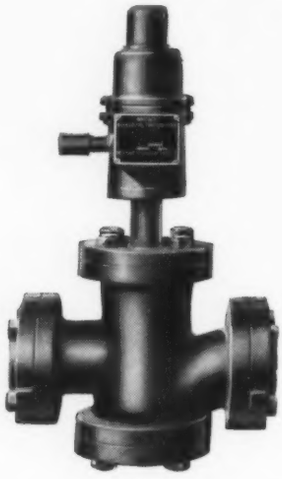

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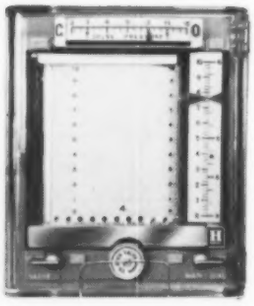

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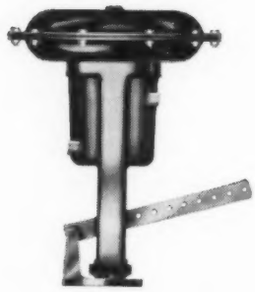

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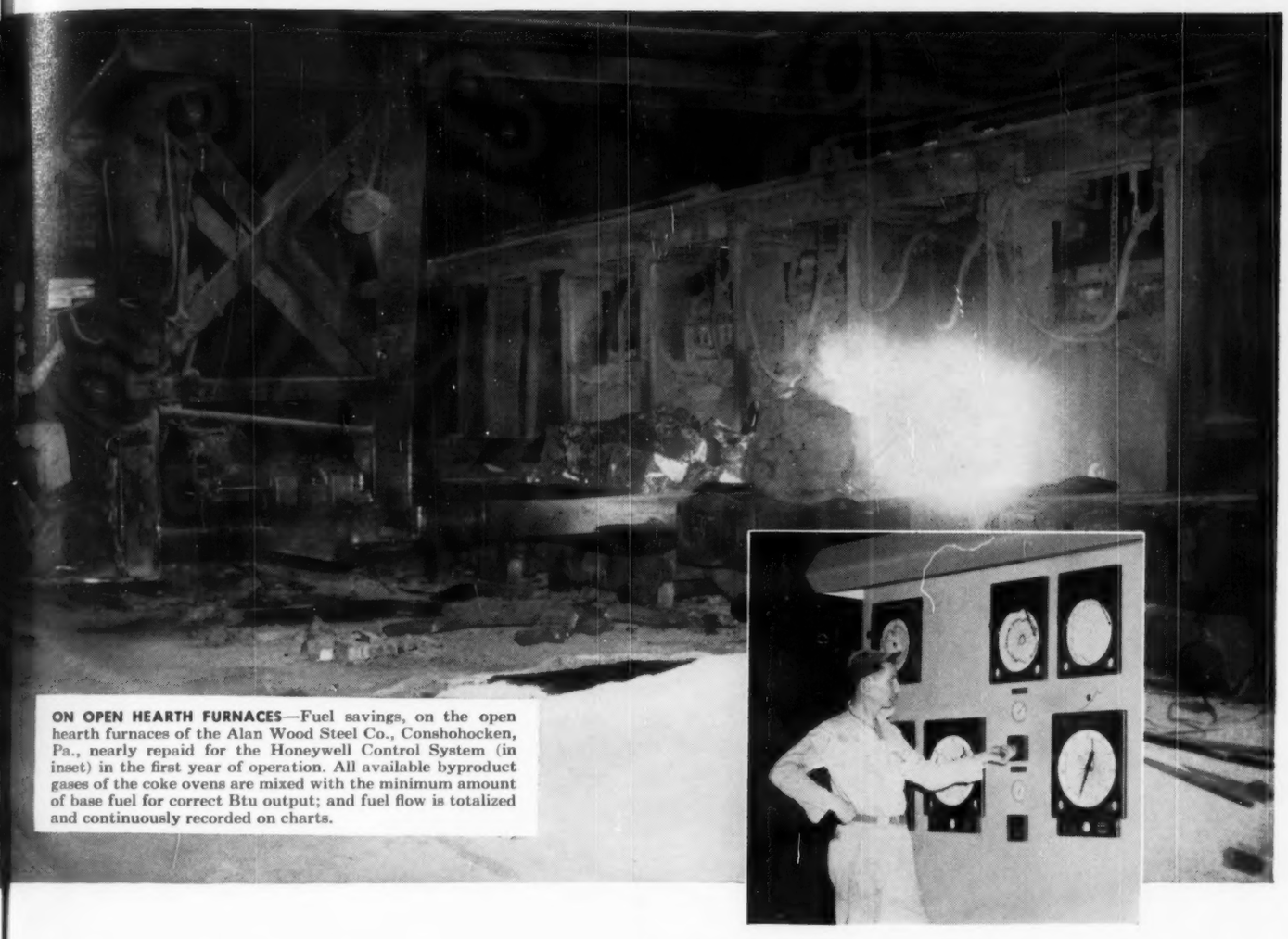

ON OPEN HEARTH FURNACES—Fuel savings, on the open hearth furnaces of the Alan Wood Steel Co., Conshohocken, Pa., nearly repaid for the Honeywell Control System (in inset) in the first year of operation. All available byproduct gases of the coke ovens are mixed with the minimum amount of base fuel for correct Btu output; and fuel flow is totalized and continuously recorded on charts.

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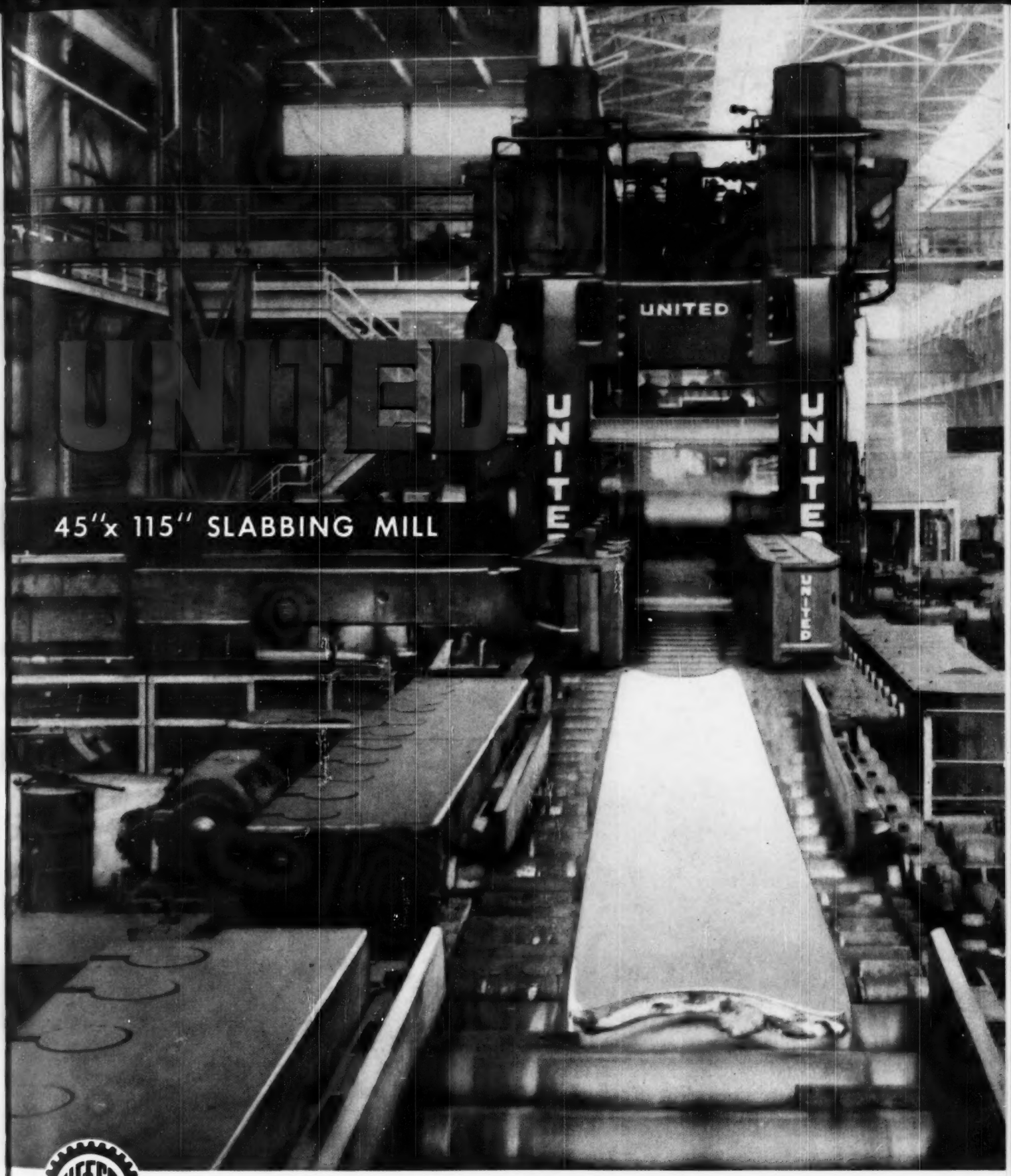

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HOW TO CONTROL ATMOSPHERES . . .

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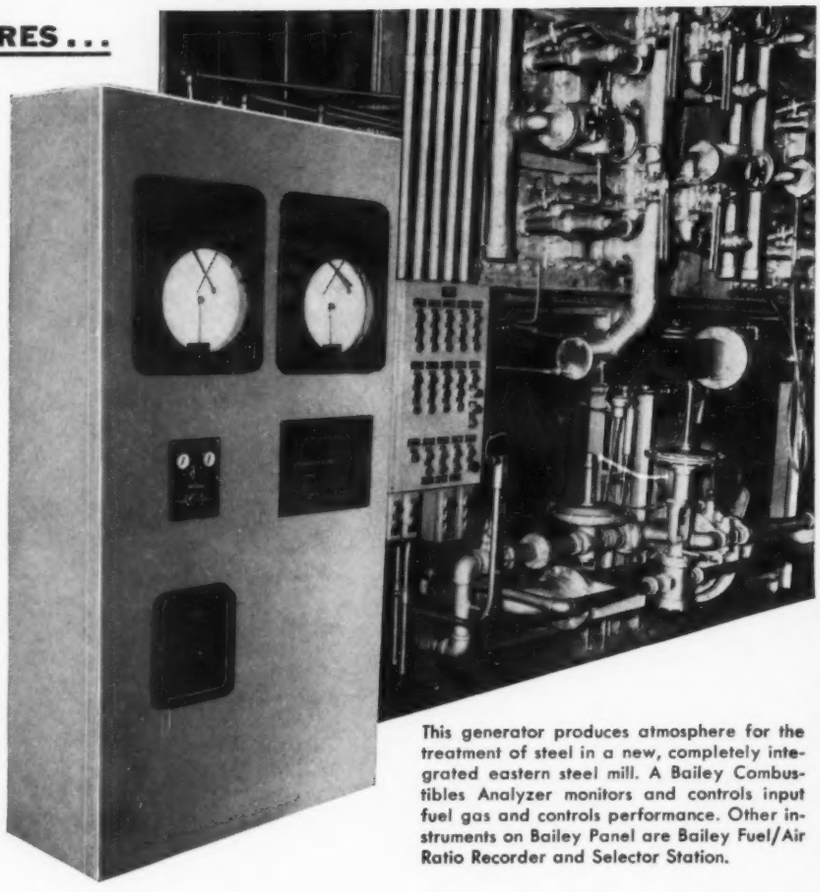

This generator produces atmosphere for the treatment of steel in a new, completely integrated eastern steel mill. A Bailey Combustibles Analyzer monitors and controls input fuel gas and controls performance. Other instruments on Bailey Panel are Bailey Fuel/Air Ratio Recorder and Selector Station.

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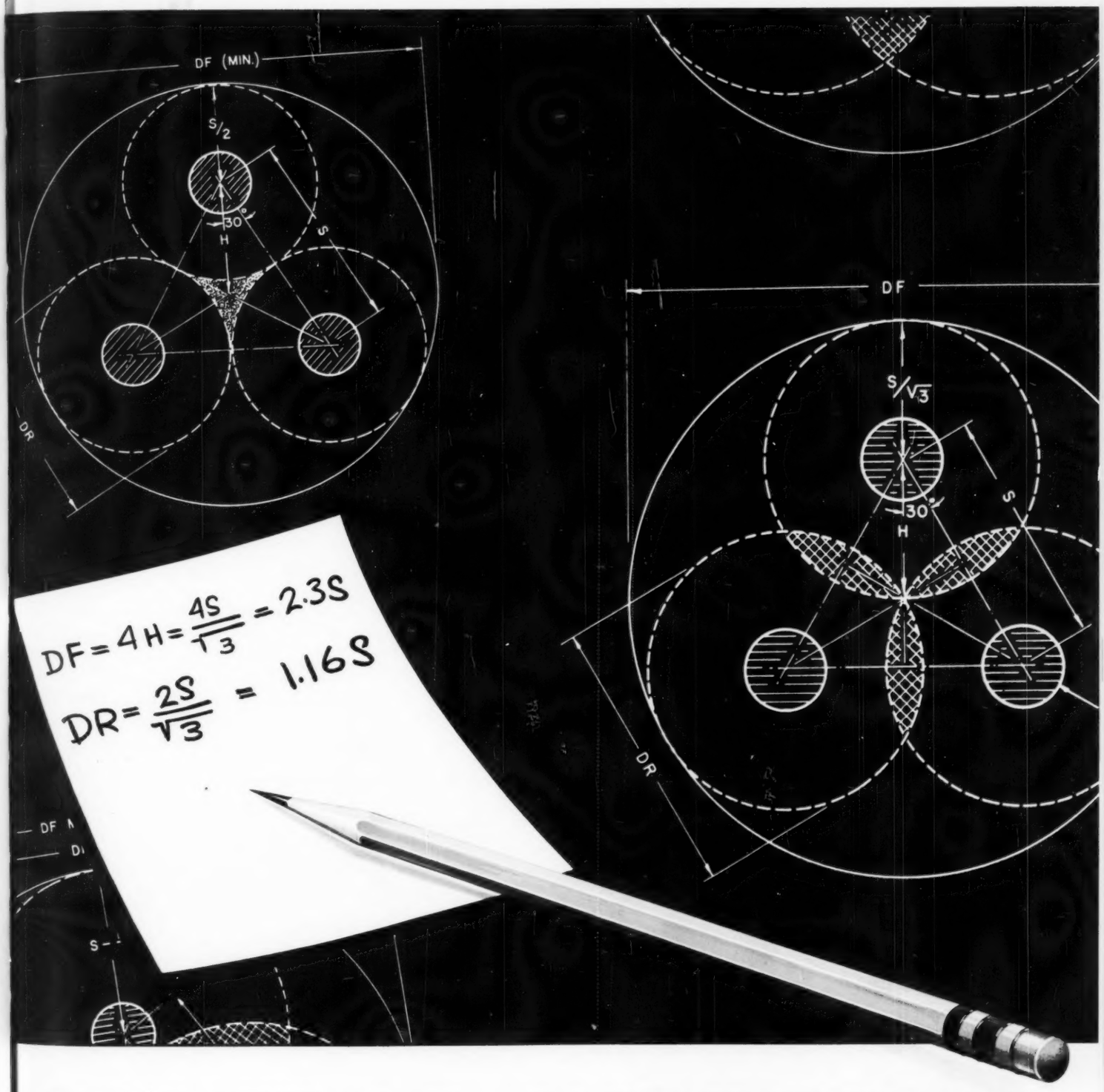


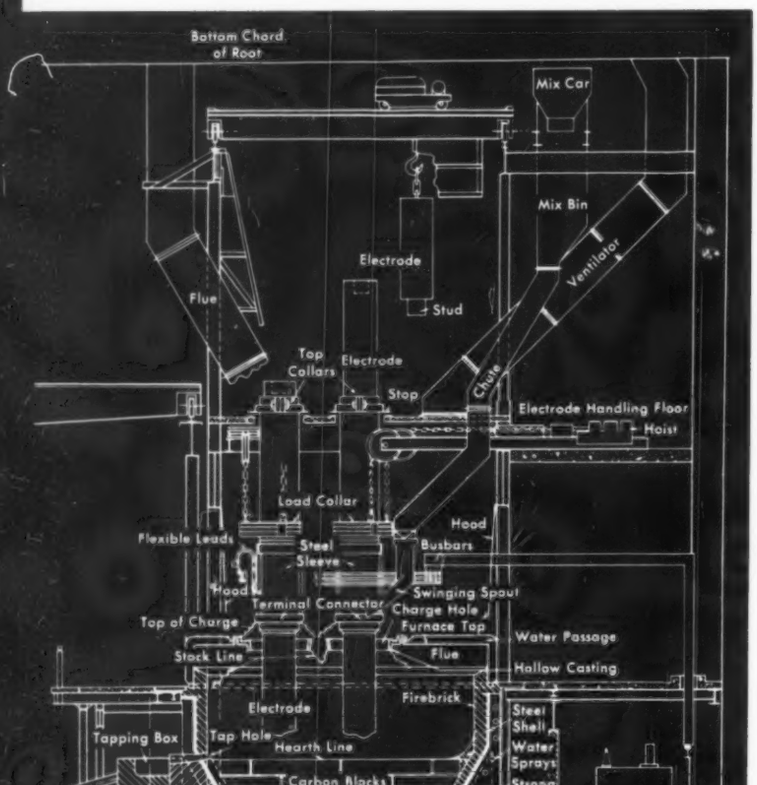
DESIGN AND CONSTRUCTION OF THE SUBMERGED ARC FURNACE

By W. M. KELLY, *Plant Metallurgist*, Niagara Works
Electro Metallurgical Company, Division of Union Carbide Corporation

DESIGN AND CONSTRUCTION OF THE SUBMERGED ARC FURNACE

. . . THE MODERN METALLURGICAL TOOL

By W. M. Kelly, *Plant Metallurgist*, Niagara Works
Electro Metallurgical Company, Division of Union Carbide Corporation



The Submerged Arc Furnace is a modern metallurgical tool for producing such industrial products as: Alloys, Calcium Carbide, Abrasives, Pig Iron, Phosphates and Titanium Dioxide. Shown is general cross section of typical ferroalloy furnace, auxiliaries and supporting structure.

Introduction

The first commercial submerged arc furnaces were placed in operation in the late 19th century. To a large degree their design has remained (for over a half century) a matter of arbitrary decision without formalization to ensure the most suitable metallurgical conditions. In general, this type of furnace has been designed almost entirely from the standpoint of the electrical universe it represents and several outstanding papers have been written concerning the electrical design of these heavy current furnace circuits.

The concept of a submerged arc furnace as a large, high temperature chemical vessel was little explored, and only trial and error information concerning furnace sizes, shapes, depths and electrode sizes was available. Gradually it was discovered that certain furnaces were suitable for given products, but eminently unsuitable for others. As the variety of alloys and materials produced by submerged arc smelting grew, the need arose for a system of predicting desirable furnace characteristics.

During the 1920's, F. V. Andreae developed the concept of electrode periphery resistance designated by the formula:

$$k = \frac{E \pi D}{I}$$

where k = electrode periphery resistance
E = electrode-to-ground voltage
I = current per electrode
D = electrode diameter in inches

This relationship, known as a "k" factor, was arrived at by observation of vast furnace data and noting that given smelting operations seemed to have a typical product of furnace resistance and electrode circumference. Although published in several papers by Mr. Andreae, it went almost unused for many years. Later, Mr. Andreae expanded on the concept by equating the heat generated by current flow in an electrode with the heat conducted from an electrode submerged in a high temperature zone and combined this equation with the electrode periphery resistance concept. It was concluded from this combination that the power density in an electrode must be constant if it is a valid assumption that electrode periphery resistance is a constant. Thus a beginning was made to a useful relationship between electrical conditions of a furnace and the metallurgical results.

During the early 1940's, after consultation with Mr. Andreae, the writer applied this concept to an accumulation of phosphorus furnace and ferroalloy furnace data for various products. In 1950, ranges of "k" factor were established for the principal submerged arc operations. This was based on the furnace data then available. From these data an attempt has been made to derive additional information relating to "k" factors and to associate this information with other design and operational considerations to formalize a suitable system for designing submerged arc furnaces with metallurgy in mind.

Electrical Conditions

Since submerged arc furnaces are *electric* furnaces, it is of prime design importance that there be a thorough understanding of the relation between electrical conditions and

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metallurgical results. Obviously a 10000 kw. furnace cannot be run at an indiscriminate voltage, and so the voltage-current relationship for a given load must be understood. The "k" factor concept provided this understanding for constant power densities.

Typical "k" factor values for the major submerged arc furnace operations are shown in Figure I. These ranges for a given product merely reflect the available data and were a first attempt to provide an orderly picture of the range of electrical conditions employed by these operations. In a few cases, such as 50% ferrosilicon, data were available for an exceptionally wide range of conditions. The figures shown represent the area where maximum performance results were obtained.

TYPICAL "K" FACTORS FOR SUBMERGED ARC OPERATIONS

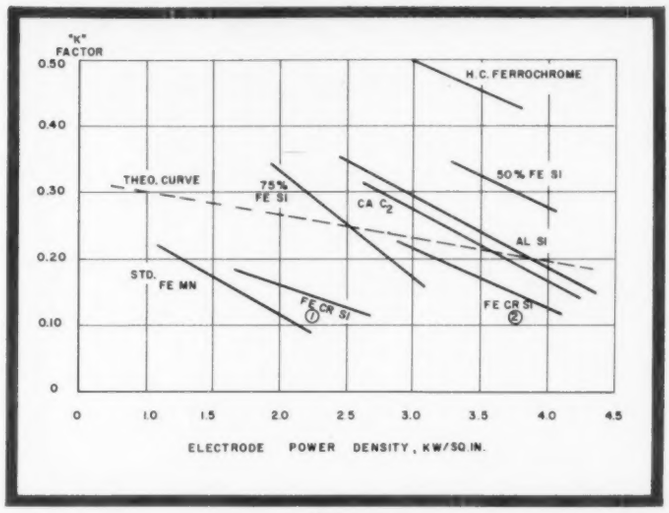
PRODUCT	"K" FACTOR
PHOSPHORUS	.75 — 1.00
H.C. FE CR (Low Si)	.35 — .65
50% FE SI	.24 — .34
H.C. FE CR (High Si)	.20 — .30
CA C_2 (Continuous)	.19 — .22
(Packets)	.28 — .32
75% FE SI (Continuous)	.16 — .20
(Packets)	.25 — .30
FE CR SI (2-Stage)	.12 — .17
SI MN	.10 — .15
STD. FE MN	.08 — .13

(FIGURE I)

The high-carbon ferrochrome (low silicon) designates the normal sales grades of ferrochrome containing 4-6% carbon and 2% silicon. High-carbon ferrochrome (high silicon) indicates the process grades of alloy containing approximately 6% silicon, but also encompasses present day charge chrome and minimum 7% carbon grade. Each of the specific grades of ferrochrome will demand its own specific range of electrical conditions.

Most of the figures represent data taken from covered three-phase furnace operations, although, open furnaces and single-phase furnace data are also included and fall in the same ranges. Two ranges are shown for both calcium carbide and high per cent ferrosilicons. In both cases the higher range represents the electrical conditions employed by the old design rectangular packet furnaces.

The range of electrical conditions represented by these figures constituted a challenge to the development of a furnace design principle that would relate electrical, dimensional and metallurgical requirements. For each operation where sufficient information was available, a study was made of the relationship of electrical conditions to such factors as efficiency, recovery, alloy composition and similar performance characteristics. The random design experience of the industry had resulted in furnaces of quite different dimensions and electrode sizes for given loads, and data were available for given operations at widely different power densities. A broad relationship between power density and "k" factor has gradually been accumulated for most of the major products shown in Figure II. Part of these data were compiled from information gathered in Europe which allowed an extrapolation not previously available from Electro Metallurgical Company data alone.



(FIGURE II)

These curves in Figure II do not represent all of the random operating experience available. Rather, they are selected data representing what is known to be satisfactory working areas for fully competitive performance. Operations on many of these products at "k" factors far removed from the indicated relations are often encountered in the industry. For example, 50% ferrosilicon has often been produced at a "k" factor of 0.15 compared to the level above 0.30 shown on the curve. Such operations were normally substandard in some performance phase, and the indicated curves represent satisfactory operating conditions so far as present knowledge can define them.

It was previously noted in connection with Figure I that packet furnace data for calcium carbide and high per cent ferrosilicons indicated consistently higher "k" factors than did continuous electrode furnaces. The slopes of the curves for these products in Figure II are thus determined. One of the notable features of the packet furnaces was invariably the fact that much lower power densities, in terms of kw/sq. in. of electrode cross section, were employed as compared to the continuous electrode furnaces. This fact raised the question of whether there was an electrode "shape factor" to be taken into account. The inclusion of European data, where operations are generally conducted at lower power densities, provided curves of the same general slope for continuous electrodes as those derived from packet furnaces. The curve for standard ferromanganese is a typical example of data derived only from continuous electrode operations. It was thus concluded that shape of the electrodes did not have a major distorting influence.

Other curves shown included both single-stage and two-stage ferrochrome-silicon, an experimental aluminum-silicon operation previously published, and low-silicon high-carbon ferrochrome.

If the voltage and current were both held constant for a particular operation while the electrode size was increased, the result would be a lower power density and higher "k" factor. A theoretical curve for such a case is also shown on Figure II and the slope represents the effect of changing electrode size at constant voltage and current values. Note that the actual curves tend to exceed the slope of the theoretical curve and, therefore, represent a real change in electrical conditions attributable to the power density.

The initial stages of design for a submerged arc furnace must take these electrical relations into account. No other

feature of furnace design can be properly determined until the desired "k" factors for the products in question have been determined and suitable power densities are in mind. Proper evaluation of these relations depends on the accumulation of a wide variety of operating results. The elaboration of this data, however, can provide a reliable and permanent basis for submerged arc design tailor-made to the product under consideration.

Electrode Size

It has been the practice to select electrode size for a submerged arc furnace based on the anticipated current density for the operation contemplated. In general, an arbitrary decision is made concerning the power to be integrated and economics has dictated the highest possible current density in order to keep capital cost to a minimum. Expressed another way, it has been the practice to operate a given unit at the highest load that the electrodes would allow in order to extract maximum production from the unit; normally this maximum production does not coincide with the point of optimum performance.

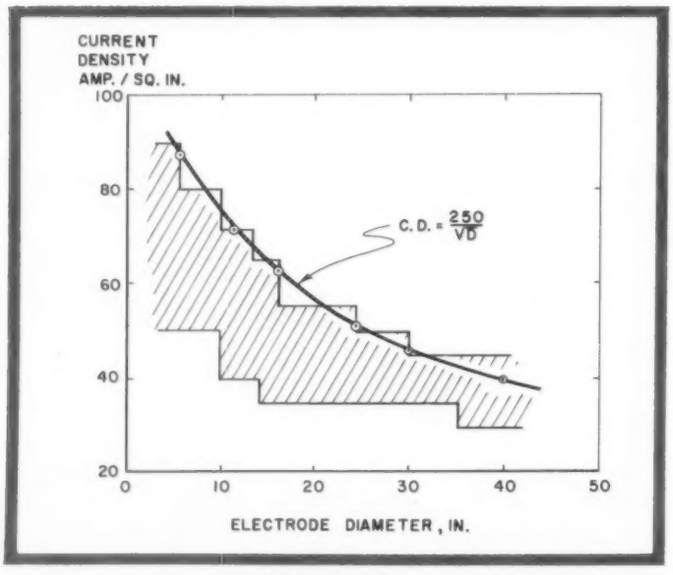
For the purposes of consistent design, it is necessary to bear metallurgical results in mind and some factor other than electrode size might more appropriately be made the limiting factor. Once the unit is properly arranged for optimum performance, it can then be operated at the proper economic level with a reasonable insight into the consequences. Selecting electrodes by current density is unsatisfactory since it tends to provide for good electrode performance without regard to metallurgical performance. Since reasonable limits to current density are important, it becomes necessary to relate this parameter to the other electrical conditions dictating the furnace design.

Figure III presents a graphical illustration of the generally accepted current density values for standard prebaked carbon electrodes. Superimposed on this graph is a curve derived from the empirical equation:

$$C = 250/\sqrt{D}$$

where C = current density, amp./sq. in.

D = electrode diameter, inches



(FIGURE III)

This equation represents the high edge of the current density range as shown by the graph and should provide a useful basis for furnace design which would assure satisfactory electrode performance.

This guide to maximum current densities plays a most important role in operations having a low "k" factor, such as standard ferromanganese where current densities at suitable power densities always tend to run high. Many other operations utilizing high "k" factors will be properly designed at current densities far below this maximum guide.

Under the present system of design, the first estimate of electrode size would be made from the power density – "k" factor relations of Figure I. Choice of power density should be influenced by accumulated experience, ability to obtain the corresponding "k" factor—taking transformer limitations and reactances into account, and finally by the effect of these choices on electrode current density using Figure III as a guide.

For example, suppose it is desired to design a 7000 kw. standard ferromanganese furnace. By selecting points from the appropriate curve relating power density and "k" factor (Figure II), it is possible to calculate the required electrode size, arc voltage and secondary current to satisfy that relationship. The resulting current densities can then be checked against the current density guide until values approaching the curve $C = 250/\sqrt{D}$ are obtained. Thus satisfactory conditions for both metallurgical performance and electrode performance are obtained. Actual figures for the case in question are tabulated. These calculations show that for a 7000 kw. load, a power density of 2.2 requires an electrode of 37 inches diameter but results in an excessively high current density for good electrical performance.

SELECTION OF ELECTRODE SIZE
STANDARD FERROMANGANESE

DESIRED LOAD KW 7,000 KW-3 PHASE			
"K" FACTOR (from curve)	.10	.14	.12
POWER DENSITY	2.2	1.8	2.0
ELECTRODE SIZE FOR P.D.	37	40	38.5
ARC VOLTAGE	45	51	49
SEC CURRENT	52000	45500	49400
CURRENT DENSITY	48.5	35	42.5
ALLOWABLE C.D. (from guide)	42	40	41

(FIGURE IV)

Assuming there is a choice of standard sizes in prebaked electrodes, a 35 inch diameter would be eliminated from consideration and a 40 inch diameter, being the next larger standard size, would be chosen. This electrode would result in a slightly lower power density and allow a slightly higher "k" factor. The current density in this case would be below the maximum considered satisfactory. An academic balance would indicate an electrode of 38.5 inches should be chosen to arrive at agreement between allowable and actual current densities within the limits of the other electrical requirements.

Electrode Spacing

After determination of desired load, electrical relationships and electrode size, the next important feature of three-phase furnace design to be determined is electrode

spacing. In the past, this has been arrived at by experience and various arbitrary relations. One design method commonly employed has been to allow a clearance between electrodes equal to one electrode diameter. For relatively easy smelting operations, this is sometimes increased to two electrode diameters. Many of the covered all-purpose furnaces in the industry have a typical electrode spacing of 1.5 diameters clearance. This dimension has been dictated, at least in some degree, by the clearance requirements for accessory equipment over the furnace and has only passing relationship to metallurgical performance. In some operations such as continuous electrode smelting of high per cent ferrosilicon, it has been found desirable to compress this spacing to nearer one electrode diameter clearance.

Recently, an attempt was made to develop a design theory along the lines that electrodes represent point sources of heat and that the heat radiated spherically in all directions. Under this assumption, the electrode spacing could be related to the cube of the reaction zone diameter. If a suitable spacing were known for a given operation at a fixed power input, it would be possible to design furnaces of any other size based on this proportionality. At low power densities, the assumption that the electrodes represent point sources of heat becomes less and less valid. The heat does not radiate spherically, partly as a result of the reflecting effect of the large electrode itself. This approach was therefore discarded in favor of the theory that power is dissipated over a fixed area of reaction zone and the kilowatt input is proportional to the square of the reaction zone diameter.

In order to test the relationship between electrode spacing and power input, data were accumulated from 50% ferrosilicon operations where the greatest variety of furnace sizes and loads was available. On the assumption that operating experience had led to a proper electrode spacing for the furnaces of various loads, the linear, area and volume proportionalities were calculated. The results of the area calculation are shown in Figure V.

ELECTRODE SPACING VS LOAD
50% FERROSILICON

ACTUAL FCE LOAD, KW.	ACTUAL SPACING, FT.	CALCULATED SPACING, FT.	RATIO CALC./ACTUAL
12000	8.5	9.2	1.08
10900	8.5	8.8	1.03
10560	8.5	8.6	1.01
10100	8.5	8.4	.99
11400	8.0	8.9	1.11
11050	8.0	8.8	1.10
10770	8.0	8.7	1.08
9500	8.0	8.1	1.01
7570	6.0	7.3	1.21
4320	5.5	5.5	1.00
4150	5.0	5.4	1.08

(FIGURE V)

The basis for the calculated spacings was taken to be an 8.5 foot spacing at a load of 10250 kw. This relation was selected due to a long record of particularly good furnace performance under these conditions.

Using the linear proportionality, a ratio of calculated to actual spacing for the furnaces in question ranged from 0.68 to 1.18, or a net range in ratio of 0.5. The volume proportionality resulted in a net range in ratio of 0.28 while the area relation gave the lowest net range of 0.22. General agreement between actual and calculated spacings was good throughout the entire range on an area basis, while the volume relations tended to stray off at the low end and the linear relation deviated widely at both ends of the range.

These data, and knowledge of the actual performance characteristics of all the furnaces listed, were taken as adequate indication that a furnace design rationalization based on an area concept was preferable to one based on either a linear or volume principle. It appeared satisfactory to assume that furnace load is proportional to the square of the electrode spacing.

Fundamental furnace design data for each submerged arc operation can be collected by studying the performance of existing furnaces and arriving at load and spacing relationships that are proved satisfactory. Any other furnace size can be properly dimensioned based on this proportionality.

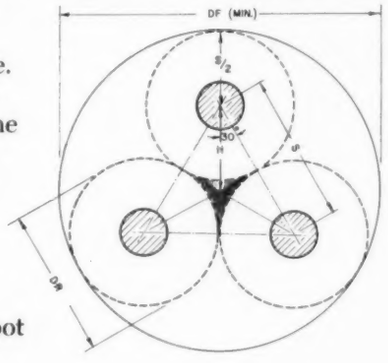
Reaction Zone and Crucible Diameter

With the acceptance of the area concept of power dissipation in a submerged arc furnace, it becomes possible to speculate on the size of reaction zones and to relate these zones to electrode spacing.

The first insight into the relationship is provided by determining the minimum possible reaction zone. Figure VI shows the relationship between minimum reaction zone diameter and electrode spacing for a triangularly arranged furnace. In this figure, minimum reaction zones are drawn about each electrode so that the edges just touch between electrodes. By normal trigonometric relations it can be shown that this minimum reaction zone diameter, D_r, is equal to the electrode spacing and that the minimum furnace diameter, D_f, circumscribing these reaction zones is equal to 2.16 times the spacing. Thus when: $D_f = 2(H + \frac{S}{2}) = 2.16S$, $D_r = S$.

It stands as self-evident that this arrangement would measure the minimum reaction zone. Any diameter less than this would not allow the flow of fluid materials from one electrode to another. In fact, the shaded area at the center junction of the three zones represents an undesirable dead spot in the furnace.

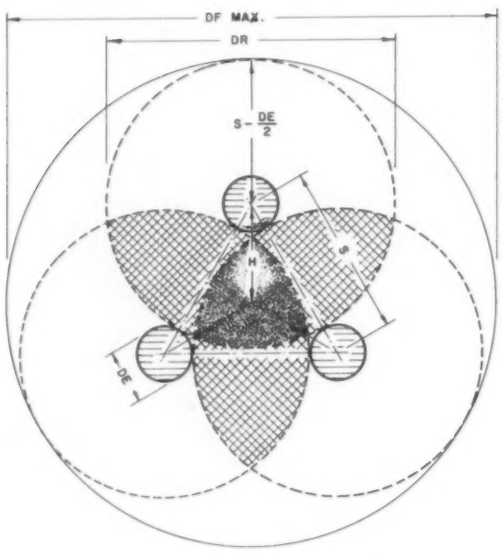
MINIMUM FURNACE REACTION ZONE



(FIGURE VI)

For the other extreme, a maximum reaction zone was assumed to be one in which the edge of one reaction zone extended to the edge of the electrode centered in an adjoining reaction zone, as shown in Figure VII. In this case, it can be shown that the maximum reaction zone D_r is equal to twice the spacing, less the diameter of one electrode. Thus when: $D_f(\text{Max.}) = 2[H + (S - \frac{DE}{2})] = 2.31S - DE$, $D_r = 2S - DE$.

MAXIMUM FURNACE REACTION ZONE



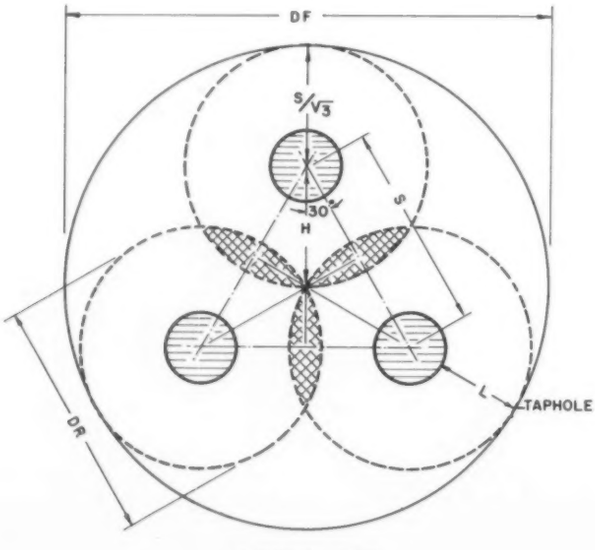
(FIGURE VII)

The maximum furnace diameter, D_f, circumscribing these reaction zones is represented by the equation shown in the figure.

In the center shaded area in this case, all three reaction zones overlap, in what would be an overly active and uncontrollable region of a submerged arc furnace. This represents the opposite undesirable extreme from the dead zone between minimum reaction zones.

After studying these extremes, it was concluded that an optimum furnace reaction would be one in which adjoining zones slightly overlapped and where all three just touched in the center, without leaving either a dead or an overactive center area. Such a condition is shown in Figure VIII. This diagram indicates that the relationship between reaction zone and electrode spacing is for the reaction zone to be equal to 1.16 times the spacing. The active furnace diameter corresponding to these reaction zones would then be 2.3 times the spacing. Thus when: $D_f = 4H = \sqrt{\frac{4S}{3}} = 2.3S$, $D_r = \sqrt{\frac{2S}{3}} = 1.16S$.

OPTIMUM FURNACE REACTION ZONE



(FIGURE VIII)

Furnace Shell Diameter

The foregoing equations provide a basis for determining the diameter of the actual furnace crucible. Practical experience has indicated that it is not desirable to have the molten zone contact the furnace lining. It appears that an empirical addition to the calculated furnace diameter, D, is desirable. Existing furnace data suggest that the diameter of crucible inside the lining should be approximately 1.15 x D_f.

In the design of many furnaces, it has been customary to place the center of the electrode triangle slightly in front of the center of the shell. This practice tends to ensure that the tap hole area is the weakest part of the furnace and burnthroughs are not likely to occur at other places around the circumference. This practice tends to result in shells of larger diameter than necessary and it is recommended that the center of the electrode triangle and furnace shell coincide. In the case of rotating hearth furnaces, this symmetry is essential.

One of the critical furnace dimensions is the distance from the electrode face to tap hole and in order to satisfy this dimension, the electrode triangle has been moved forward. This distance varies for different operations for the same reason that electrode spacing varies; i.e., due to varying refractoriness of the materials being smelted. The electrode spacing and distance to tap hole should be related. From Figure VIII, it can be seen that distance from electrode face to reaction zone can be expressed by the equation $L = \sqrt{\frac{S}{3}} - \frac{DE}{2}$

Furnace Depth

One of the most difficult features of furnace design to reduce to formal relationships is furnace depth. Various empirical approaches in the past have included such relations as voltage per foot of depth, without being adequate measures of depth requirements. Using the theory that electrode tips are point sources of heat, the suggestion arises that power input is proportional to the cube of depth. This relation does not seem to bear out in actual practice and the point source theory was discarded in the case of electrode spacing.

Observation of many furnace reaction zones during digouts and repairs has led to certain useful information. In smelting operations such as the ferrosilicons, ferrochrome-silicon and aluminum-silicon alloys, it has been noted that a highly conductive matrix of hearth metal fills the bottom of the furnace to a depth within inches of the point that the electrode tips have operated. In certain operations where electrode tips have normally been 60 inches off hearth, there will be upwards of 55 inches of conductive hearth metal beneath the electrode.

It has been customary to think of the interior of a submerged arc furnace as being occupied by materials in progressively more complete states of reduction, ranging from raw materials at the surface to final product at the hearth line. The heavy layer of hearth metal always encountered, now suggests that the furnace is actually divided into two relatively distinct zones. Below the electrode tips is the observed hearth metal of high conductivity, reasonably uniform composition, and essentially reacted material. Above the electrode tips are the unreacted and partially reacted raw materials of relative nonconductive nature.

In the upper zone of the furnace, heat transfer must be

preponderantly through the mechanism of convection, since this is the zone where reaction occurs and hot reaction gases are rising. In the lower zone, relatively little gas passes to aid convection. The more highly conductive nature of the hearth metal suggests heat transfer in this zone is predominantly by conduction.

From a practical operating standpoint, it is desirable to suffer as little heat loss as possible and the temperature of the off-gases from the surface of the furnace should be kept to a minimum. This factor governs the desired furnace depth from mix surface to electrode operating depth. On this basis, the upper portion of the furnace can be treated essentially as a packed tower with heat being transferred from the hot gases to the particles of mix.

The usual relationships for such a case indicate that the rate of heat flow is directly proportional to the unit heat transfer surface, the coefficient of heat transfer, the cross sectional area of the mix bed, the depth of heat transfer bed and the temperature difference.

In the design of an electric furnace for a given smelting operation, the transfer coefficient and unit heat transfer surface would be constant mix characteristics determined by the raw materials for any size furnace. Similarly, the desired temperature difference would be a constant. A previous relation has indicated that the electrode spacing and the area should be proportional to the load.

Under these circumstances it is evident that the rate of heat flow is directly proportional to the depth. It is indicated that at constant power density, the depth of mix from electrode tip to surface would be constant for any size furnace. With increases in power density, this depth should be increased proportionately.

The lower portion of the furnace burdened with hearth metal can be represented as a large heat conductor where flow of heat is directly proportional to thermal conductivity, area and temperature differential, and inversely proportional to depth.

For a given smelting operation, both thermal conductivity and temperature differential are constants and the rate of heat flow is directly proportional to the area and inversely proportional to the depth of hearth metal. Since the sensible heat in tapped metal is a significant energy loss, it is desirable to tap at the lowest temperature consistent with the hot metal handling techniques and skulling characteristics of the alloy involved.

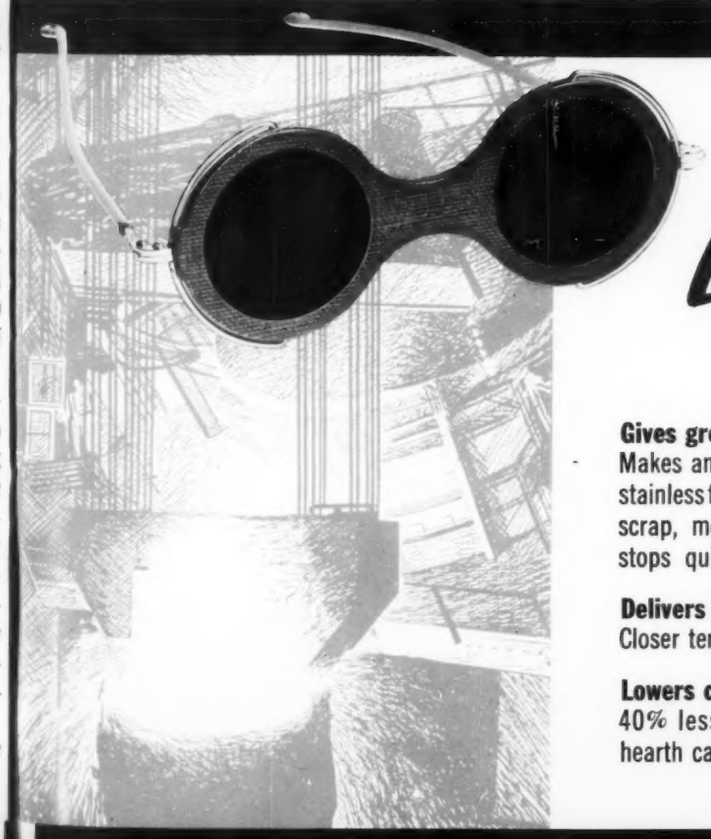
For any given power density and accompanying heat distribution pattern, the amount of heat lost in the tapped metal would be dependent on the depth of hearth material. An increase in power density would tend to demand an increased depth of hearth metal to keep conducted heat from increasing. It is concluded that the two zones of depth should be constant for constant power density, regardless of total load, and increases in power density must be accompanied by proportional increases in furnace depth to maintain the same level of heat losses.

Although these concepts of heat flow in a submerged arc furnace are oversimplifications of actual conditions, they nevertheless provide a consistent basis for design.

A useful relationship, therefore, becomes the ratio of inches of electrode submerged in the mix to the distance of electrode tips off hearth. This ratio varies widely with different smelting operations and typically ranges from 3.0 to 0.3 for the normal alloys produced. Knowledge of these values materially aids in proper furnace design for a given operation.

Dimensional Relations — Packet & Continuous Electrode Furnaces

Before the days of covered submerged arc furnaces, a common design arrangement was a rectangular furnace shell with three rectangular electrodes arranged in line. These rectangular electrodes were made up of groupings or packets of square carbons. Hence, this type of furnace became known as a packet furnace.



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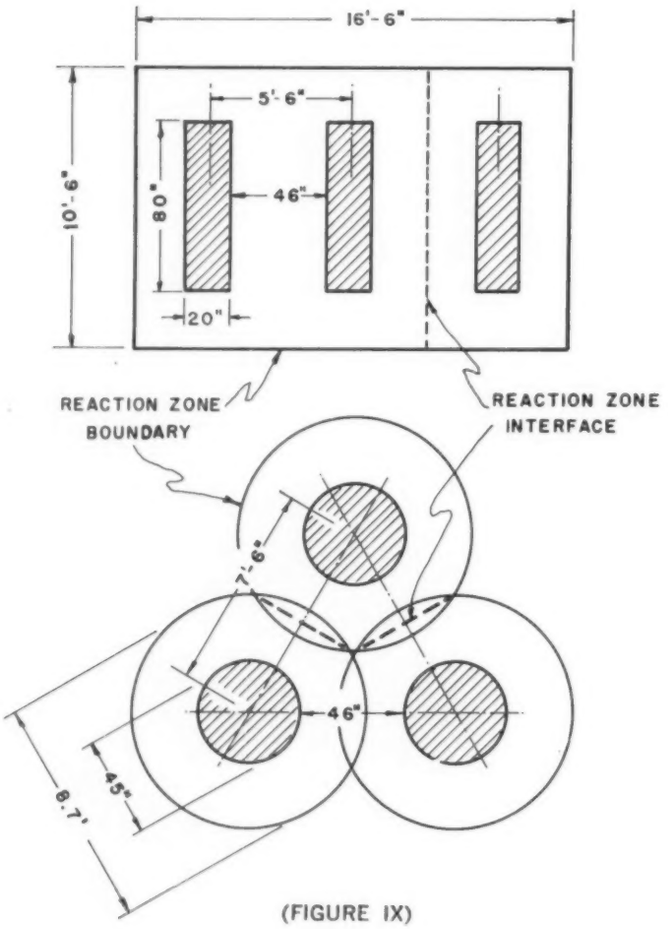
One of the more difficult problems in the past has been the translation of results from packet furnaces to continuous electrode furnaces. Many operations have been repeatedly demonstrated to be less satisfactory in continuous electrode furnaces than in packets.

Some of the more obvious differences in conditions of packet furnace operation have been the higher "k" factors and very much lower power densities that they employed. In order to design a continuous electrode furnace with the characteristics of a packet furnace, the concept of minimum reaction zone was applied to packets.

A typical packet electrode arrangement is exemplified by furnaces using three 20" x 80" electrodes arranged in a line on 5'6" centers or with 46" clearance between electrodes. A minimum reaction zone, therefore, extends mid-

8500 KW FERROSILICON FURNACES



(FIGURE IX)

way between electrodes, or approximately two feet. If it is assumed that the reaction zones extend out equally all around the electrode, it is possible to determine the entire furnace reaction zone size.

The reaction zone shown for a typical packet furnace measures 10.6 x 16.6 feet, based on the minimum reaction zone concept. It is interesting to note that actual reaction zone measurements made on this type of furnace have verified within inches the estimated reaction zone size.

Under the assumption that the reaction zone extends to the center of the area between electrodes, the two reaction zones of adjacent electrodes must join for the full length of the electrode. In continuous electrode furnaces, the minimum reaction zones join only at a point. A condition more comparable to the packet furnace, therefore, is the optimum reaction zone where the zones overlap slightly to approximate the line contact between packets. With this reasoning as a basis, it is then possible to approximate packet furnace conditions in a continuous electrode furnace.

A continuous electrode furnace equivalent to this packet would have 45" electrodes on 7' 6" centers. The electrode power density in both cases is 1.76 kw/sq. in., the reaction zone area per electrode is equal (58 sq. ft.) in both cases and therefore the reaction zone power density is equal at 49 kw/sq. ft. and the distance between electrodes is essentially equal in both cases.

It is felt that the application of these principles to continuous electrode furnaces, based on packet furnace data, would allow the solution to many metallurgical problems characteristic of the continuous electrode furnaces. The trend indicated for continuous electrodes, based on comparison with the older packets, would be to larger diameters for existing loads.

Conclusion

These design principles have been gradually evolved and applied so far as possible in the solution of various metallurgical problems. It is fully recognized that a vast amount of additional information is desirable and that certain of the present concepts are controversial. It is strongly felt, however, that the continued development of submerged arc furnaces depends upon the formulation of a system of design that relates the two important elements involved – electricity and metallurgy. It is hoped that this presentation will stimulate interest in the problem of proper metallurgical design and will serve as the basis for the continued development of much more complete design relationships.

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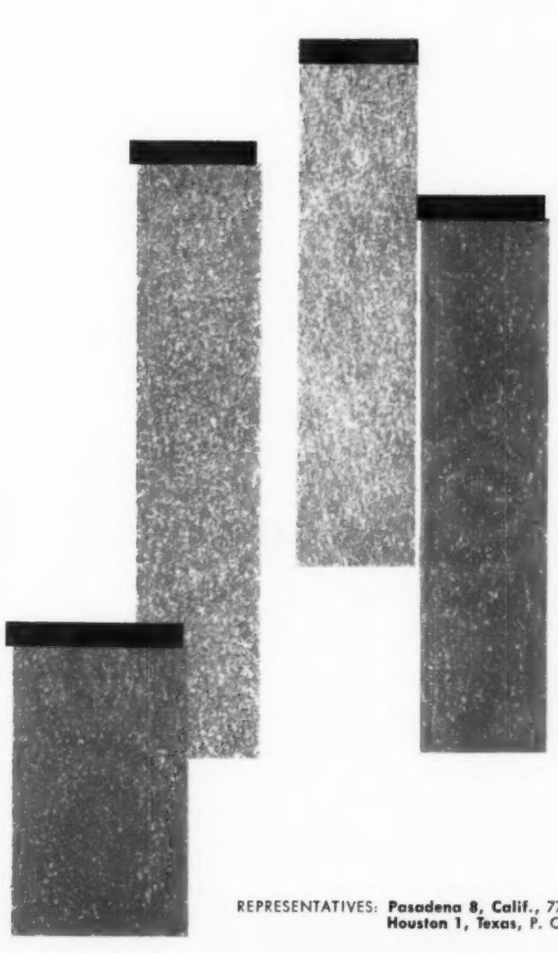

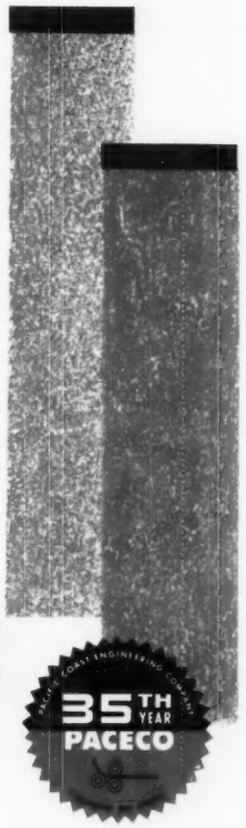

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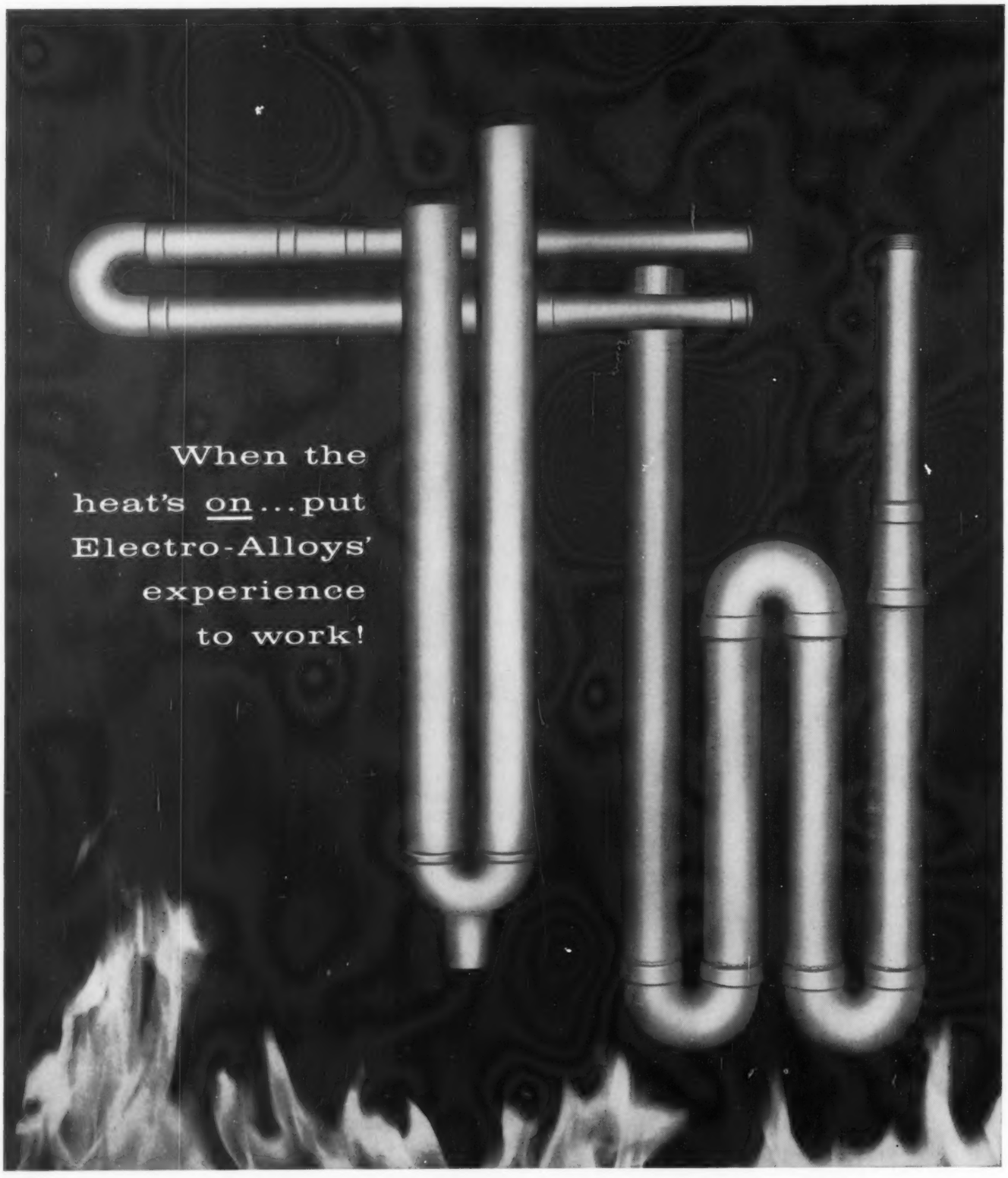

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patent reviews

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents . . . . patents reviewed cover period November 5, 1957 through December 3, 1957.

GALVANIZING PROCESS

△ U. S. 2,813,044, issued Nov. 12, 1957 to Allan E. Chester and assigned to Poor & Co., provides a galvanizing process which is characterized by enhanced ductility of the zinc coating.

The improvement consists of surface treating the ferrous metal with a coating of chromium aldonate, preferably chromium gluconate. The coating of the chromium aldonate is preferably held on the surface of the ferrous metal by a film forming substance which adheres to iron, preferably a film of a cationic substance, which decomposes in the molten zinc to liberate a free fatty acid.

BLAST FURNACE CONTROL SYSTEM

△ U. S. 2,814,479, issued Nov. 26, 1957 to Otto J. Leone, provides apparatus for controlling blast furnaces, to prevent slips and rolls.

According to the inventor, particularly in the case of low pressure blast furnaces with limited permissible top pressures, effective and flexible control is provided by regulation of both the top gas pressure in the gas main and the pressure of the blast air supplied to the furnace through the bustle pipe and tuyeres. In this way, it is possible to automatically control a blast furnace over a relatively wide range of conditions and variables without losing power to maintain the stock in buoyant condition in the furnace, so that it moves down with good contact with the blast air supplied and without hanging or packing or building up pressure differentials across any levels in the furnace shaft exceeding those above which hanging, channeling, slipping or rolling may result.

Apparatus is also provided for detecting slips or rolls, whether incipient or occurring, by means of the *rate* of increase of top gas pressure.

REMOVAL OF PHENOL FROM BY-PRODUCT COKE PLANT WATERS

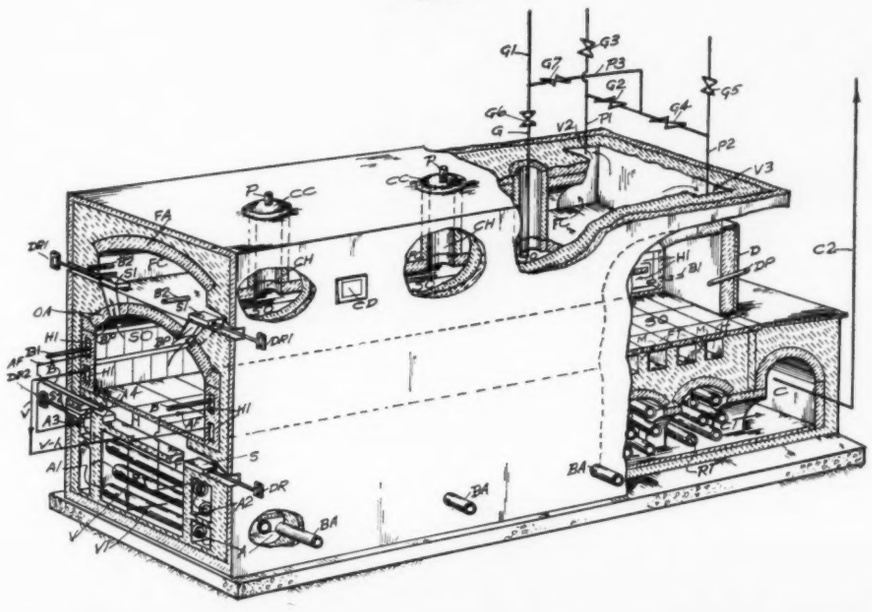
△ U. S. 2,812,305, issued Nov. 5, 1957 to Dan P. Manka, assigned to Jones & Laughlin Steel Corp., describes a method for the removal of phenol from phenol-bearing waters from by-product coke plants.

The phenol is removed by solvent extraction with toluene. About 1 to 3½ per cent by volume of 2-methyl-5-ethylpyridine has been found to increase greatly the ability of the solvent to extract the phenols.

BROAD OVEN FOR TREATING ACID HYDROCARBON SLUDGES

△ U. S. 2,812,291, issued Nov. 5, 1957 to Charles H. Hughes, assigned to Hughes By-Product Coke Oven Corp., describes an oven for ther-

Figure 1



mally treating acid sludge produced in the refining of coke oven distillates, to yield oxides of sulphur which can be converted to sulphuric acid, as well as domestic coke.

In general, the apparatus consists of a combination oven with a fume chamber located directly above the arch over the coking chamber and within the same steel encased structure into which all of the acid vapors and hydrocarbon gases may be conducted, where the hydrocarbon gases will be burned.

The apparatus is shown in Figure 1.

ELECTROCHEMICAL COATING OF STEEL SURFACES

△ U. S. 2,812,296, issued Nov. 5, 1957 to Richard A Neish, assigned to United States Steel Corp., describes a process for treating the surface of uncoated sheet steel (black plate) to increase its corrosion resistance and the adherence of the lacquer coating usually applied to can stock, so that it can be used as a substitute for tin plate in the manufacture of cans for packing comparatively noncorrosive food products.

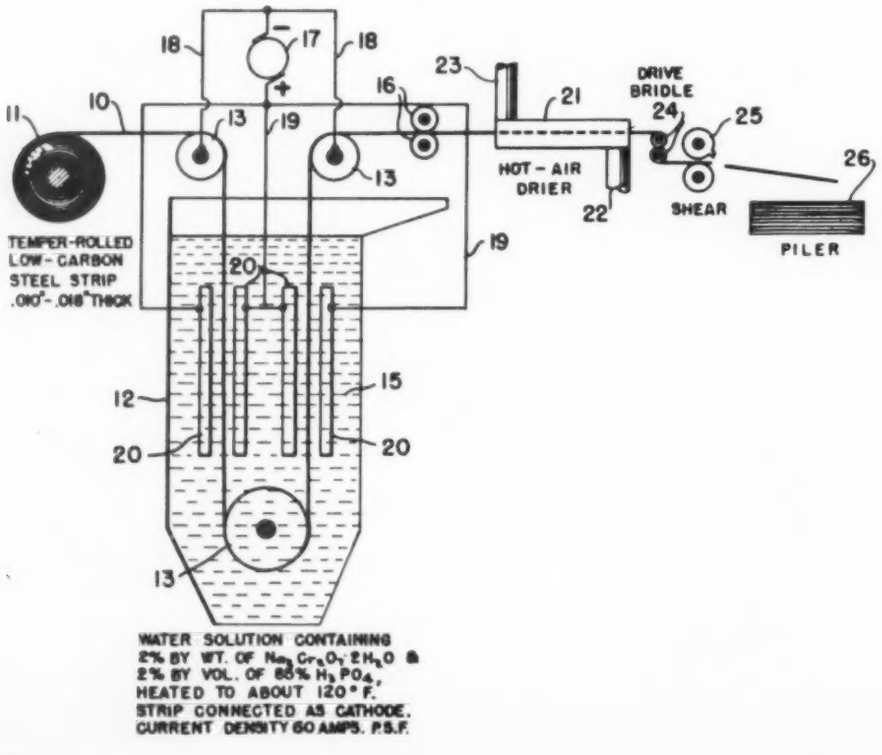
As shown in Figure 2, a cold-rolled steel strip 10 having a low carbon content (0.03 to 15 per cent) is uncoiled from a reel 11 and passed in single ply through a tank 12 fitted with guide rollers 13. The guide rollers guide the strip through a treating solution 15. Squeegee or wringer rolls 16 at the exit end wipe excess solution from the strip, leaving it uniformly covered with a thin liquid film. The bath 15 is an acid aqueous solution containing phosphate ions and hexavalent chromium ions, and has a pH of 1 to 2. Other chemicals may also be added such as sodium nitrate or potassium permanganate.

The bath 15 serves as the electrolyte in a cell connected to a current source such as a d-c generator 17. The strip passing through the tank is made the cathode in this circuit. The voltage of the generator is controlled to cause current flow between the anodes and the strip at a current density depending somewhat on the speed of travel of the strip through the tank.

It is desirable that the strip be immersed in the bath for about one sec, and the total length of the anodes is made such that the average speed of the strip will produce this result. At the minimum time, the current density should be about 90 amp per sq ft and at the maximum, about 15 amp per sq ft. For the preferred treating time, the current density should be from about 30 to 60 amp per sq ft.

For the most efficient operation, the bath 15 is maintained at a temperature between 120 and 140 F, by steam coils immersed in it. At lower bath temperatures, the film applied to the strip, after drying, is heavier but is chalky, providing neither adequate corrosion resistance nor lacquer adherence. At higher temperatures, the film is invisible and the lacquer adherence is impaired. Films produced at a bath temperature of from about 120 to 130 F are the most effective in improving the corrosion resistance and lacquer adherence and are smoky gray in appearance.

Figure 2



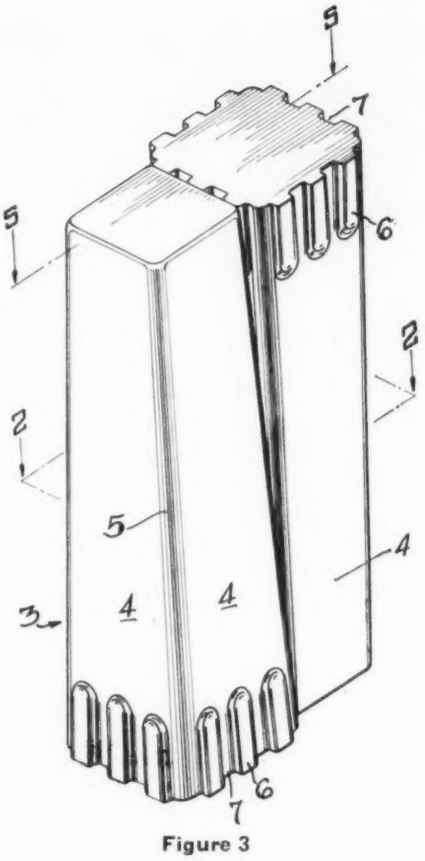


Figure 3

The cathodic electrolytic action to which the strip is subjected reduces the metallic oxide existing on the surface of the steel and forms a thin boundary film of a microcrystalline phase of unknown composition. It is believed that this microcrystalline phase then partially reacts with the solution film tending to seal the coating when it is dried. The exact nature of the reaction or the character of the coating produced on drying the residual film of the solution is not known precisely, but the effect thereof in improving corrosion resistance and lacquer adherence is readily determinable by simple tests.

INGOTS

△ U. S. 2,812,573, issued Nov. 12,

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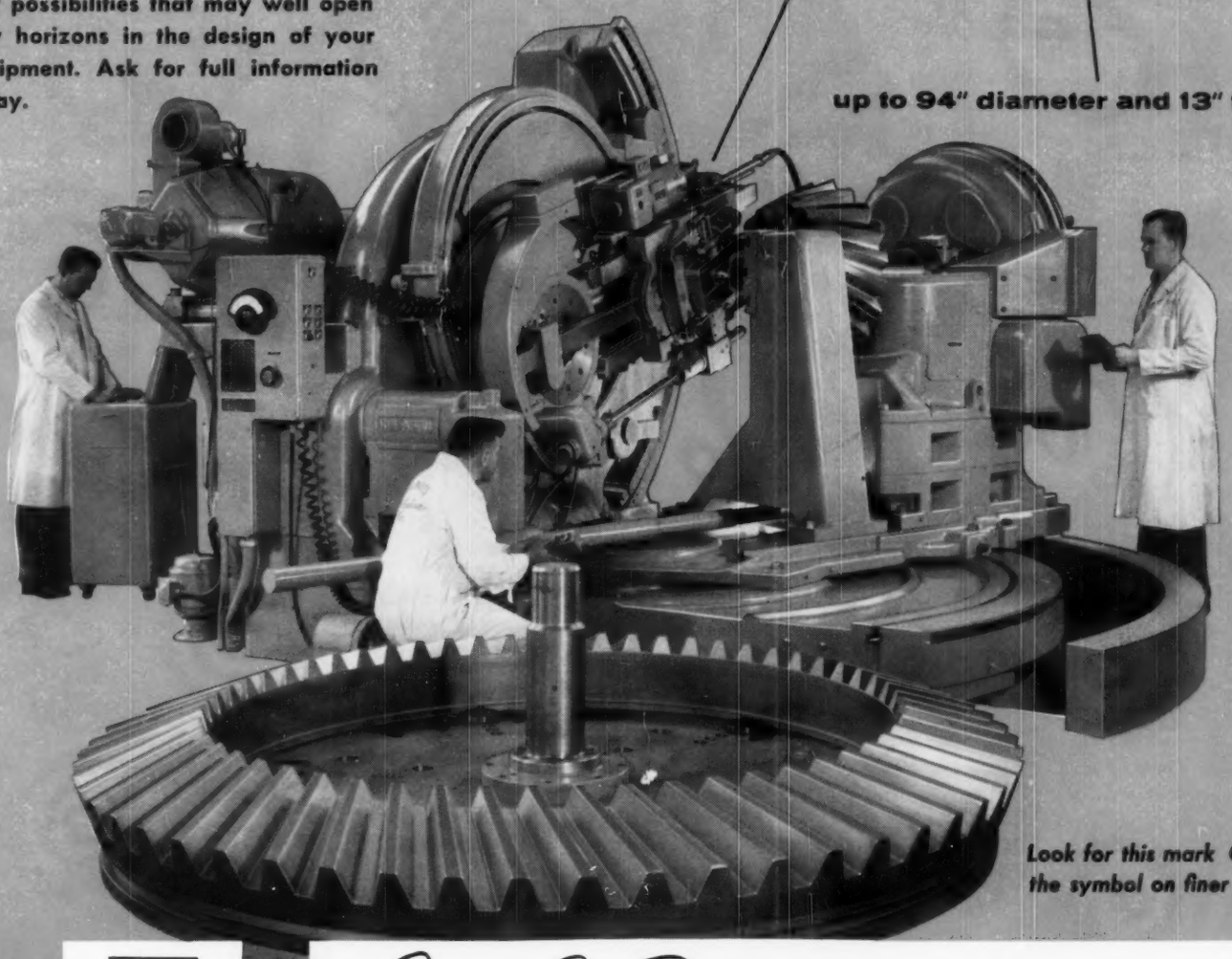

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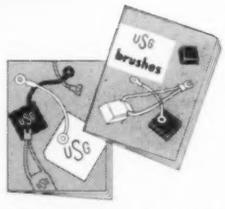


Copies of the latest USG Brush Catalog B-56 and the new USG Brush Grade Supplement are available on request.

B-254-1

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 9, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

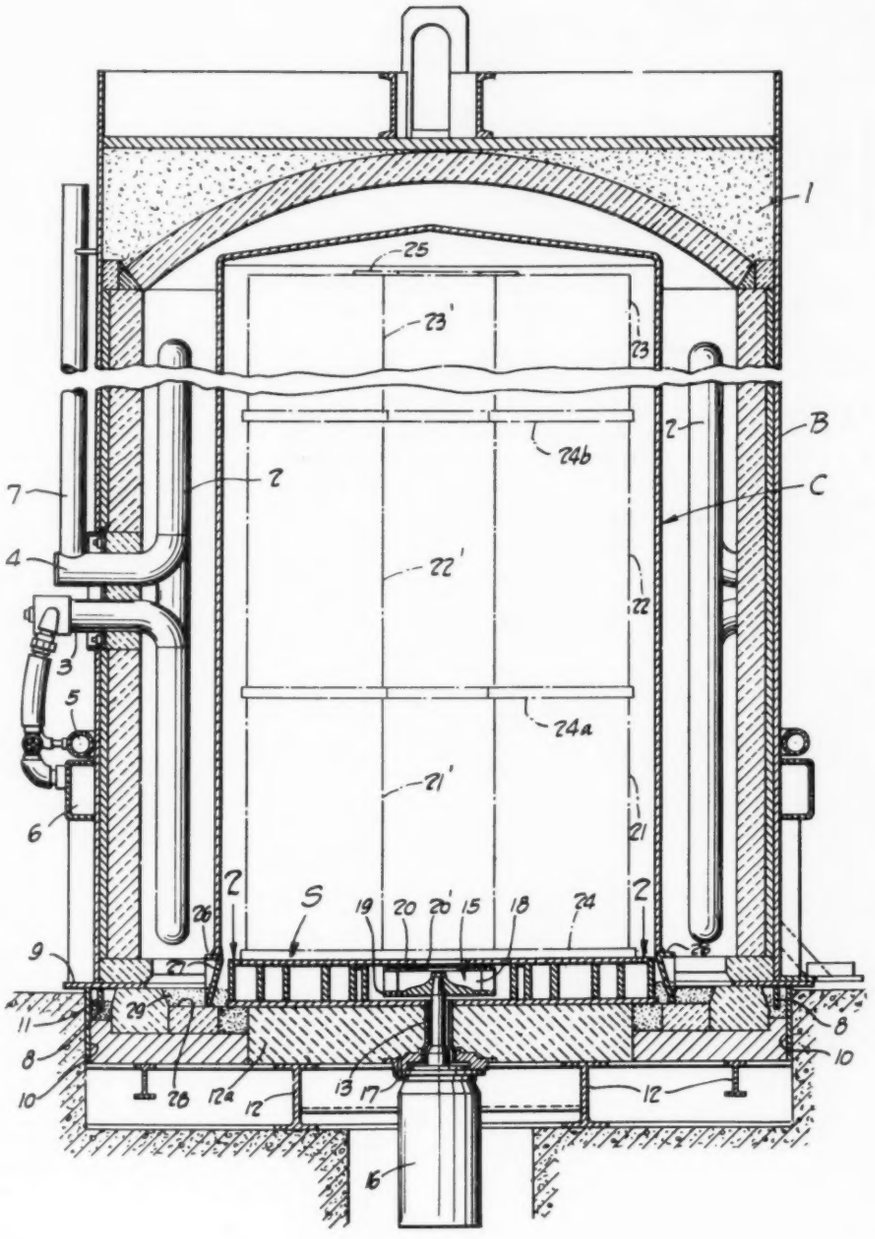


Figure 4

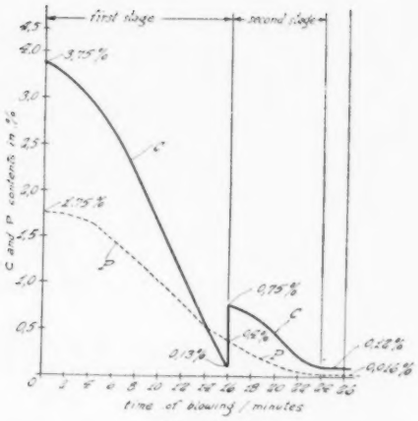


Figure 5

1957 to Earl F. May, describes an ingot of such shape that a number of them can be arranged side by side in a furnace with spaces between them for the passage of furnace gases. This effect is shown in Figure 3.

This type of ingot permits a reduction of the customary heating period in the furnace, a lower consumption of fuel and increased rate of operation.

CHARGE SUPPORT FOR BELL-TYPE FURNACES

△ U. S. 2,815,197, issued Dec. 3, 1957 to Calvin C. Blackman and assigned to Lee Wilson, describes a structure for use as a charge support and diffuser for bell-type furnaces such as are used for annealing stacks of coils of strip steel.

The object of the invention is to provide a type of apparatus which will provide an adequate support for the coils to be annealed, which will efficiently reduce the velocity pressure created by the fan and convert it to static pressure, and which at the same time will substantially eliminate rotary movement or nonuniform pressure conditions of the furnace atmosphere adjacent to the sand seal such as would result in pickup of sand.

The apparatus is shown in Figure 4.

METHOD FOR REFINING IRON BY OXYGEN BLOWING

△ U. S. 2,815,275, issued Dec. 3, 1957 to Adolf Richter and assigned to Brassert Oxygen Technik A. G., describes a process for refining high-phosphorus iron by oxygen blowing.

Gaseous oxygen is blown under a pressure of 7 to 12 atmospheres onto the surface of the molten iron by means of a jet, the outlet end of which is positioned slightly above the slag surface. The refining is done in two steps, an undiminished amount of oxygen being applied in both steps.

As shown in Figure 5, in the first step, the greater proportion of both the carbon and the phosphorus are removed under a high basic slag containing lime, iron oxides and fluxing material. The carbon is decreased to less than 0.1 per cent, and the phosphorus content to such a degree that it does not exceed five times the amount of carbon still present.

At this state the high basic and reactive slag is drawn off and pig iron pure in phosphorus is added to the charge. Due to this addition of pig iron the total carbon content of the charge is increased again to more than 0.2 per cent and at least twice and at most fifteen times the carbon percentage present in the remaining charge. Thereafter, a new dephosphorizing slag rich in lime and containing iron oxides and fluxing material such as soda is put upon the charge, and oxygen blowing is resumed at full strength until the desired carbon and phosphorus contents of the steel are obtained.

BLOWING OF PIG IRON IN A BASIC LINED FURNACE

△ U. S. 2,815,274, issued Dec. 3,

1957 to Willy Oelsen and Heinrich Rellermeyer, assigned to August Thyssen-Huette A. G., describes a method of blowing pig iron in a basic-lined furnace to produce steel.

According to one method of the present invention, the preheated blowing vessel is supplied with a certain portion of lime, for instance one-third of the total amount determined by the capacity of the vessel, and a certain portion of the pig iron, for instance one-tenth to one-third of the total amount, whereupon air or oxygen is blown into the vessel. After slag has been formed, and the pig iron has been almost completely converted into steel, pig iron and lime are continuously supplied in amounts corresponding to the amount of blown gas and the pig iron continuously blown as it is supplied, and in such manner that all impurities contained in the pig iron are uniformly burned off while the composition of the charge and the composition of the slag remain substantially unchanged. The temperature of the charge remains unchanged or rises only very slightly during the blowing. The process is terminated when the vessel is completely filled to capacity and cannot receive any further pig iron or lime.

In the present invention, the sudden temperature rise after the conversion and the rapid change of the composition of the slag which are disadvantages of the conventional Thomas process are avoided. Such temperature rise after conversion in the known processes causes among other things the high nitrogen absorption of the charge in the Thomas process. In the present invention, a much higher temperature prevails soon after the start of the process than in the conventional Thomas process, which has a favorable influence on the dissolving of scrap additions and improves the blowing qualities of the converter when the blowing is carried out from below. The high temperature level at the beginning also assures brisk reaction of the carbon. The temperature maximum reached in the present invention is not as high as in the conventional Thomas process, which constitutes a particular advantage regarding the removal of phosphorus and the low nitrogen content of the steel.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or assignee
2,812,248	11/5/57	Treating iron ores with tar	Koppers Co., Inc.
2,812,292	11/5/57	Coke oven door with sealing diaphragm	Koppers Co., Inc.
2,812,293	11/5/57	Bracing means for coke oven batteries	Koppers Co., Inc.
2,812,375	11/5/57	Power clamp for furnace electrode	McGraw-Edison Co.
2,812,571	11/12/57	Composite roll structure with hard case	Griffin Wheel Co.
2,812,673	11/12/57	Mandrel guiding arrangement for billet piercing apparatus	The Babcock & Wilcox Co.
2,812,863	11/12/57	Portable conveyor for use in rebuilding open hearth furnaces	United States Steel Corp.
2,812,866	11/12/57	Apparatus for charging furnaces	Republic Steel Corp.
2,813,643	11/19/57	Apparatus for removing coils of steel rod from a hook carrier	Morgan Construction Co.
2,813,706	11/19/57	Apparatus for handling skelp in a continuous butt-weld furnace	Republic Steel Corp.
2,813,708	11/19/57	Device to improve flow-pattern and heat transfer in heat exchange zones of brick-lined furnaces	Kurt P. H. Frey
2,813,744	11/19/57	Self-releasing chain hook	Republic Steel Corp.
2,814,476	11/26/57	Arc furnace roof	General Refractories Co.
2,814,478	11/26/57	High temperature reduction furnace	Stamicarbon N.V.
2,814,557	11/26/57	Production of titanium concentrates through the reducing smelting of titanium-containing iron ores	Societe des Blancs de Zincs de la Mediterranee
2,814,558	11/26/57	Method of reducing iron ores containing titanium	Roy A. Halversen
2,814,559	11/26/57	Production of nodular cast iron	James A. Clark
2,814,563	11/26/57	High temperature austenitic iron base nickel-free alloys	Allegheny Ludlum Steel Corp.
2,814,658	11/26/57	Electric arc furnace	Udy Metallurgical & Chemical Processes
2,814,953	12/3/57	Radiation pyrometer for open hearth furnaces	Ambrose J. Callaghan
2,815,068	12/3/57	Means for igniting and extinguishing furnace burners	Ross H. Forney and Frederick E. Forney
2,815,203	12/3/57	Device for removing and replacing the cover of a soaking pit furnace	Westofen G.m.b.H.
2,815,273	12/3/57	Production of vacuum melted stainless steel	National Research Corp.
2,815,276	12/3/57	Optical pyrometers for measuring the temperature of the metal bath during refining in the converter	Institut de Recherches de la Siderurgie
2,815,280	12/3/57	Stainless steel composition	Armco Steel Corp.
2,815,305	12/3/57	Apparatus for heat-treating metal parts	Harold N. Ipsen
2,815,316	12/3/57	Treatment of swelling and caking coals	American Cyanamid Co.

There is a constant demand for copies of "The Modern Strip Mill" published by the Association of Iron and Steel Engineers.

If your copy is not in use please get in touch with us.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

No Excessive Heating

New Rectifier Cooling System Prevents Heat Build-up and Damage

when ac Power Fails

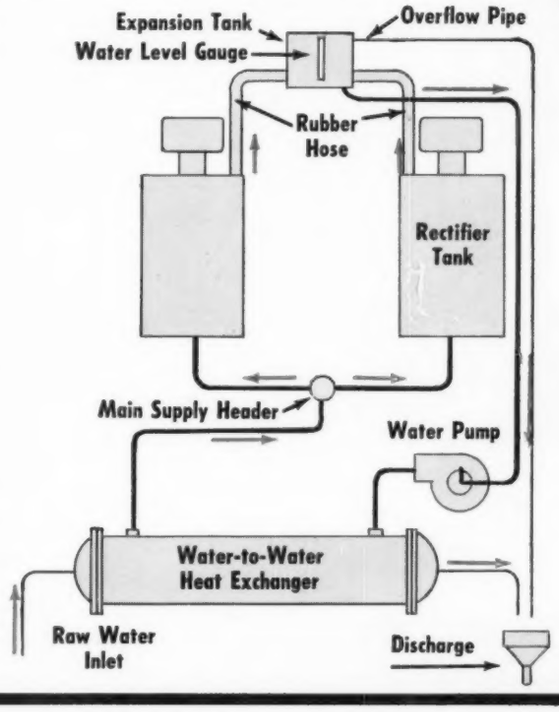
A SAFER, more effective cooling system in the Allis-Chalmers rectifier continues to circulate water *even when an ac power failure stops the water pump.* Heat and steam are dissipated before they can develop to the danger point.

The new system features an expansion tank that extends the full length of the rectifier frame with short vertical connections from each tube. With warm water continuing to flow freely upward, a thermo-siphoning action draws cooler water into the tubes. Build-up of excessive temperatures is prevented. Steam pockets are kept from forming. Subsequent water loss from the recirculating cooling system is minimized.

Successful operation in hundreds of installations is your assurance of the complete reliability of Allis-Chalmers mercury arc rectifiers. Contact your nearby A-C office or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

How the System Works

Water is normally pumped through the water-to-water heat exchanger to the main supply header from where it circulates through rectifier tubes picking up heat. Hot water flows up through the short connections to expansion tank and back down to suction side of water pump.



ALLIS-CHALMERS Mercury Arc Rectifiers

Factory-packaged units cut installation time and costs. Sealed tube rectifiers are supplied in completely enclosed or open types. Here is a typical, completely enclosed, 1000-kw, 250-volt rectifier for steel mill service.

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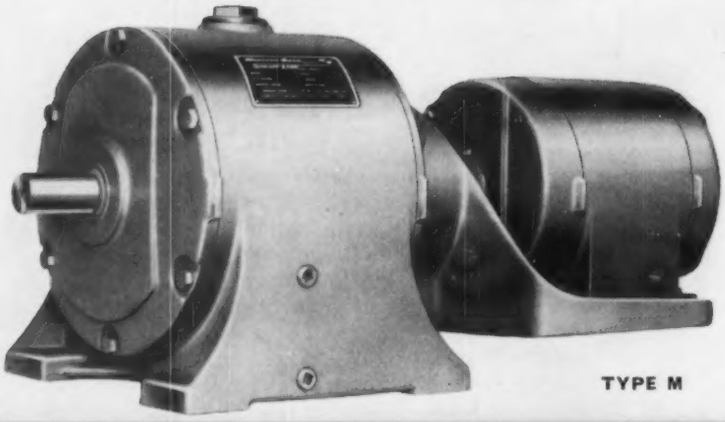
A-5425

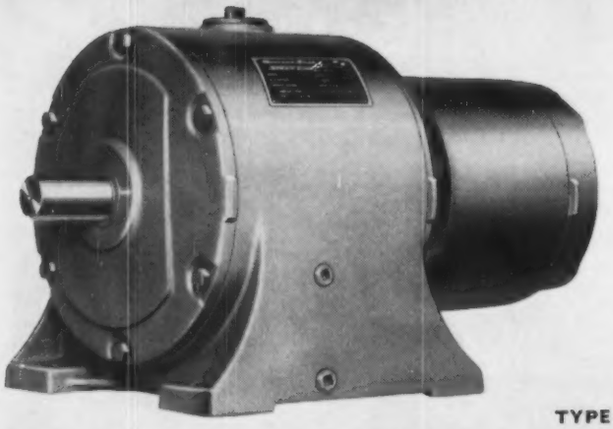
MARKETING BULLETIN

Important Gearmotor Announcement



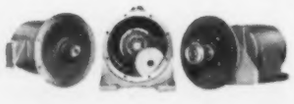
TYPE M

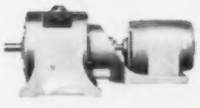
Customer-proved and -preferred advantages of this Western Gear all-motor gearmotor include: easy motor replacement; straddle-mounted high speed pinion for precision alignment; balanced heat treat to ensure long life; extra large inspection cap that eliminates removing end bells for inspection.



TYPE G

Utmost compactness is the first obvious advantage of the Western Gear integral gearmotor. Other superior points include: shank-type pinion that provides maximum strength and concentricity; precision-machined adapter that assures accurate alignment; double output shaft seal to keep oil in and foreign materials out; wide bearing spacing allowing maximum overhung loads.





Western Gear integral and all-motor gearmotors are companion products which may be converted, right in the field, simply by interchanging motor packages. Ratios changed easily and quickly, too, with no special tools. This unique advantage is of greatest importance when unforeseen requirements for different speeds or motor packages arise in the field.

Western Gear now marketing own line of gearmotors, products of 25 years of proved and preferred production for major motor manufacturers.

Western Gear Corporation announces the design, manufacture and marketing of its line of StraitLine integral and all-motor gearmotors ranging from 1 to 60 HP and from 9 to 520 RPM.

The StraitLine gearmotor combines all the best customer-preferred features proved through 25 years of manufacture for a major motor manufacturer.

Western Gear has designed its line of gearmotors utilizing the "building block" principle. This results in a minimum renewal parts inventory because of parts standardization, and in a high degree of interchangeability. Motor packages and gear sets are easily interchanged, and ratios changed simply and quickly, right in the field.

StraitLine gearmotors, both integral and all-motor, are available for immediate delivery in a wide variety of sizes and reductions, through Western Gear's district sales offices, representatives and distributors.

Glenn Malme • **Western Gear Corporation**
P. O. Box 182 • Lynwood, California ISE

Please send me information on StraitLine Gearmotors.

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title
company
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ENGINEERS AND MANUFACTURERS

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Overhead electric traveling cranes, gantry cranes,
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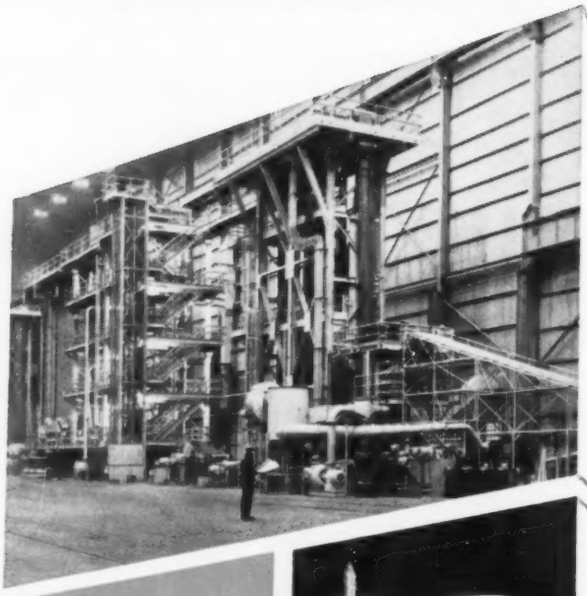
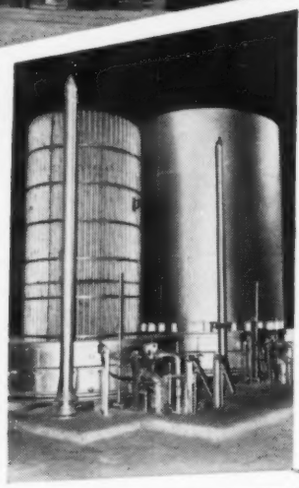
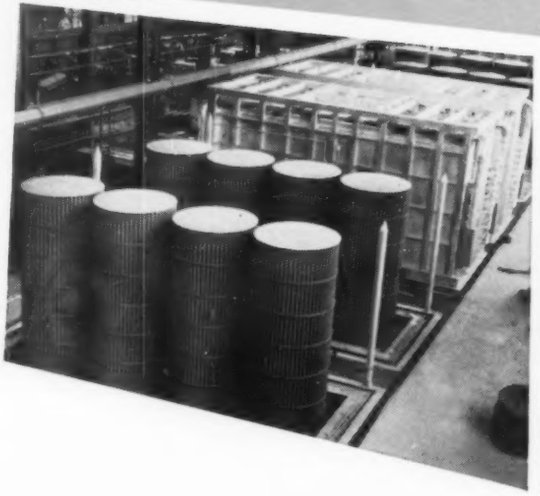


VERTICAL STRIP ANNEALER



SINGLE-STAND ANNEALERS

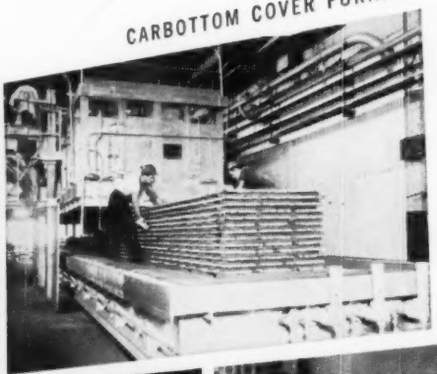
CONTINUOUS STRIP GALVANIZER



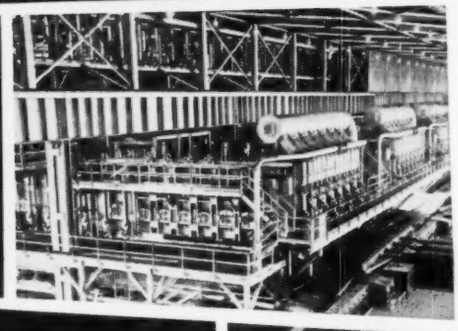
MULTIPLE-STAND ANNEALERS

foundation for steel mill profits

CARBOTTOM COVER FURNACE



ONE-WAY FIRED SOAKING PITS



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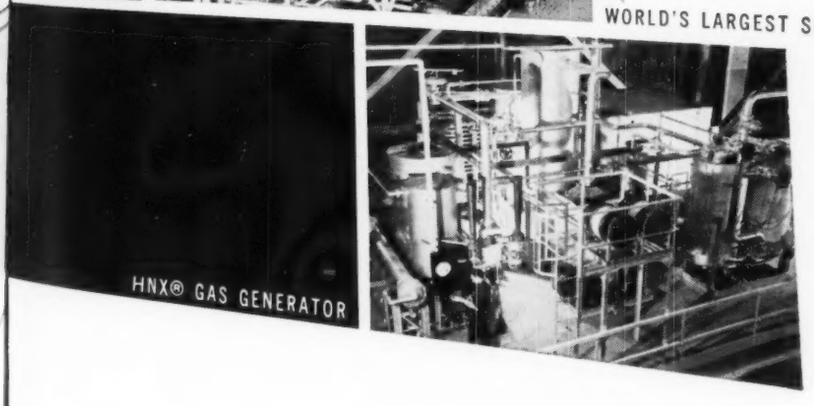

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from cold strip to slit strands
IN SECONDS...
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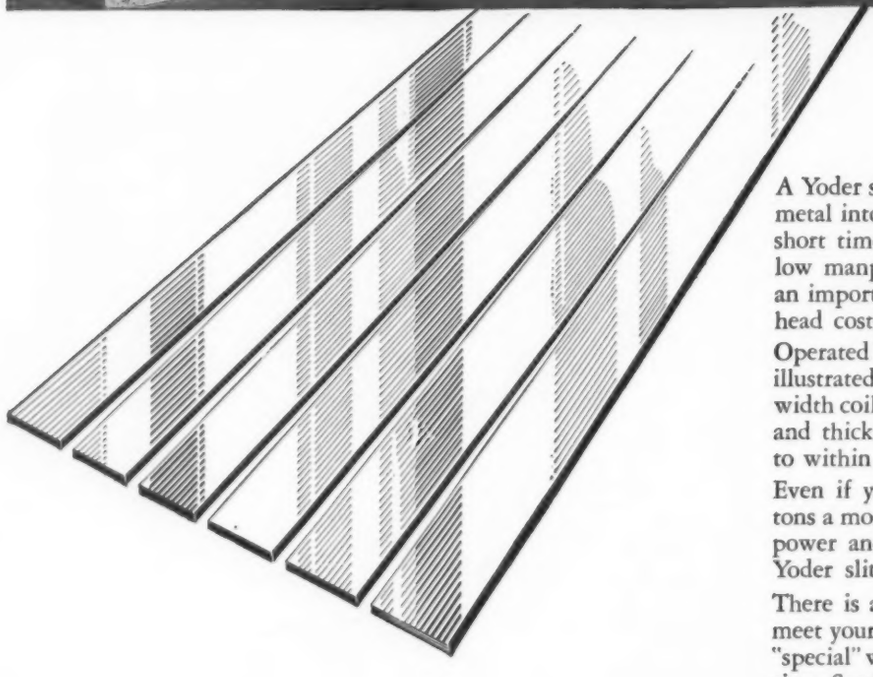
ROTARY MULTIPLE SLITTER



A Yoder slitter converts mill-width coils of flat-rolled metal into many variable-width strands in amazingly short time. Speed, coupled with great accuracy and low manpower requirements, makes a Yoder slitter an important factor in keeping production and overhead costs down.

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Even if your steel requirements are as little as 100 tons a month, the savings to be realized in time, manpower and raw material costs alone will pay for a Yoder slitter in the first few months of operation.

There is a Yoder slitter designed and engineered to meet your requirements, and to speed the delivery of "special" width stock in a wide range of large or small sizes. Send for your free copy of the fully-illustrated, 76-page booklet, "Multiple Rotary Slitting Lines."

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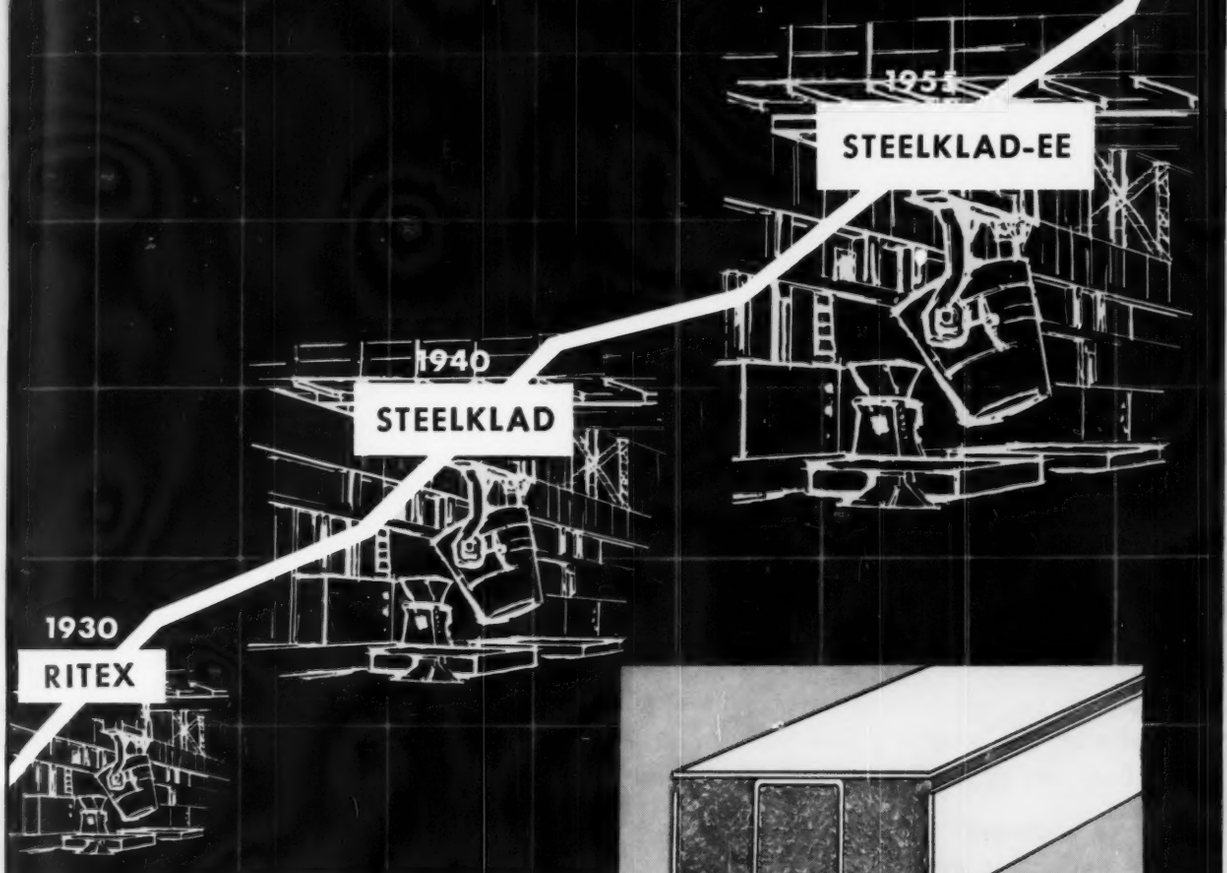
COLD ROLL FORMING MACHINES

STEELKLAD-EE

The ORIGINAL Internally Plated Brick



CROSS SECTION OF STEELKLAD-EE

Steel production in the U. S. A. has more than doubled in the last quarter century. General Refractories' constant improvement of basic brick for steel making has greatly helped this striking growth.

Early in the period of expansion Grefco pioneered the development of chemically bonded RITEX brick. In the forties Grefco's STEELKLAD provided increased spalling resistance and still better refractory quality. Continuing research and study brought about the introduction three years ago of Grefco's patented STEELKLAD-EE. These brick have now proved themselves in a great many applications. In this short time STEELKLAD-EE has won a substantial and growing portion of the basic brick market. In many applications they have demonstrated increased life of from 25% to 50% over other basic brick.

The cut-away view shows how the STEELKLAD-EE internal plates are molded into the brick, making three bricks of one. These smaller refractory units are tremendously more resistant to the spalling and peeling action which has been characteristic of most basic brick on exposure to cyclical heating and cooling.

For expert advice on the use of this outstanding, new, basic refractory, consult your local Grefco representative.

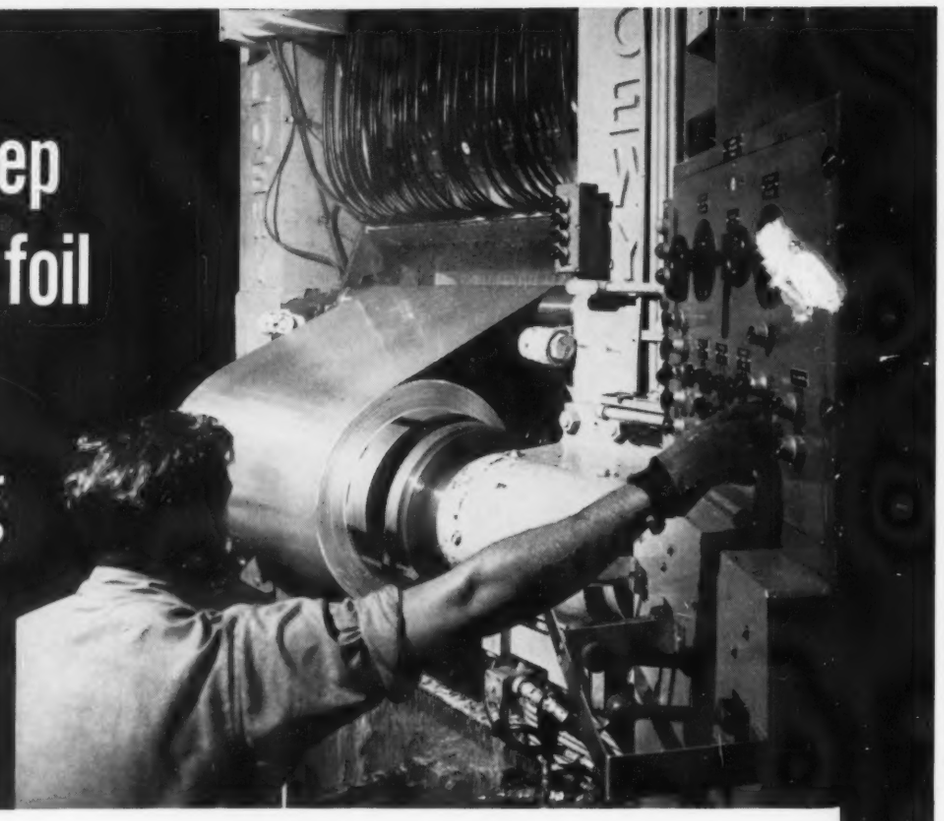
A Complete Refractories Service

GENERAL REFRACTORIES COMPANY · **PHILADELPHIA 2, PA.**

GENERAL REFRACTORIES

how to keep aluminum foil from shattering

... at 35 miles per hour!



Kaiser Aluminum & Chemical Corp. increased annual production of aluminum foil 50% at its Permanente, California plant through installation of a four high foil mill. This mill reduces aluminum strip in thickness from .026 to .00025 of an inch at speeds up to 3000 fpm.

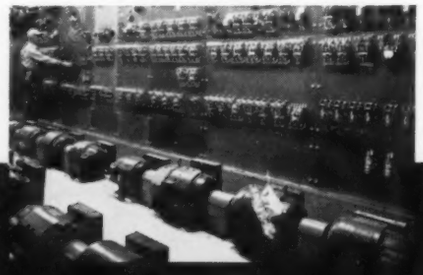
At 35 miles per hour, excessive strain at any of the several reduction stages would shatter the extremely thin foil. From the original payoff reel through to the final rewind, uniform tension is provided by Reliance V★S Drives.

Reliance engineers built this drive specifically for this mill, to provide the constant uniform tension which is so important.

This application is typical of the many diversified jobs that Reliance V★S Drives are called upon to perform. There is a Reliance V★S Drive to fit your application.

D-1562

For further details, write **Dept. 114-A**



Main control room—Where Reliance equipment provides more than 2,900 hp. to drive this mill.

RELIANCE ELECTRIC AND ENGINEERING CO.

CLEVELAND 17, OHIO · CANADIAN DIVISION: WELLAND, ONT.

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80-inch continuous hot strip mill

BLAW-KNOX CONTINUOUS HOT STRIP MILLS

Blaw-Knox designs and builds a full range of continuous, semi-continuous, and single stand reversing hot strip mills. Other Blaw-Knox equipment for the metals industry includes complete rolling mill installations including all auxiliary equipment for ferrous and non-ferrous metals, iron, alloy iron and steel rolls, Medart cold finishing equipment, carbon and alloy steel castings, fabricated steel plate or cast-weld design weldments, steel plant equipment, and heat and corrosion resisting alloy castings.

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Superex is easily combined with other insulations such as Johns-Manville Thermobestos®, J-M 85% Magnesia or J-M Insulating Fire Brick.

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In many ways, Superex® is the finest block insulation yet developed for high temperature furnace applications!

Made of diatomaceous silica and asbestos, Superex offers exceptional heat resistance—excellent insulating value. And at high temperature its stability is unsurpassed: it combines low shrinkage with excellent thermal effectiveness . . . easily withstands the physical abuse encountered in normal service.

Superex also speeds and simplifies installation. *Easy-to-handle*—Superex weighs only 2 lbs. per sq. ft. per inch thickness. *Strong*—it compresses only ⅛ inch under 6 tons' pressure per square ft. Superex is available in a wide variety of shapes and sizes . . . is easily cut with an ordinary knife or saw.

For further information write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

For medium temperature applications, specify J-M Superex M blocks . . . tor temperatures to 1600F.

Saves waste. Superex comes in 7 standard thicknesses from 1″ to 4″. Other sizes available on order.

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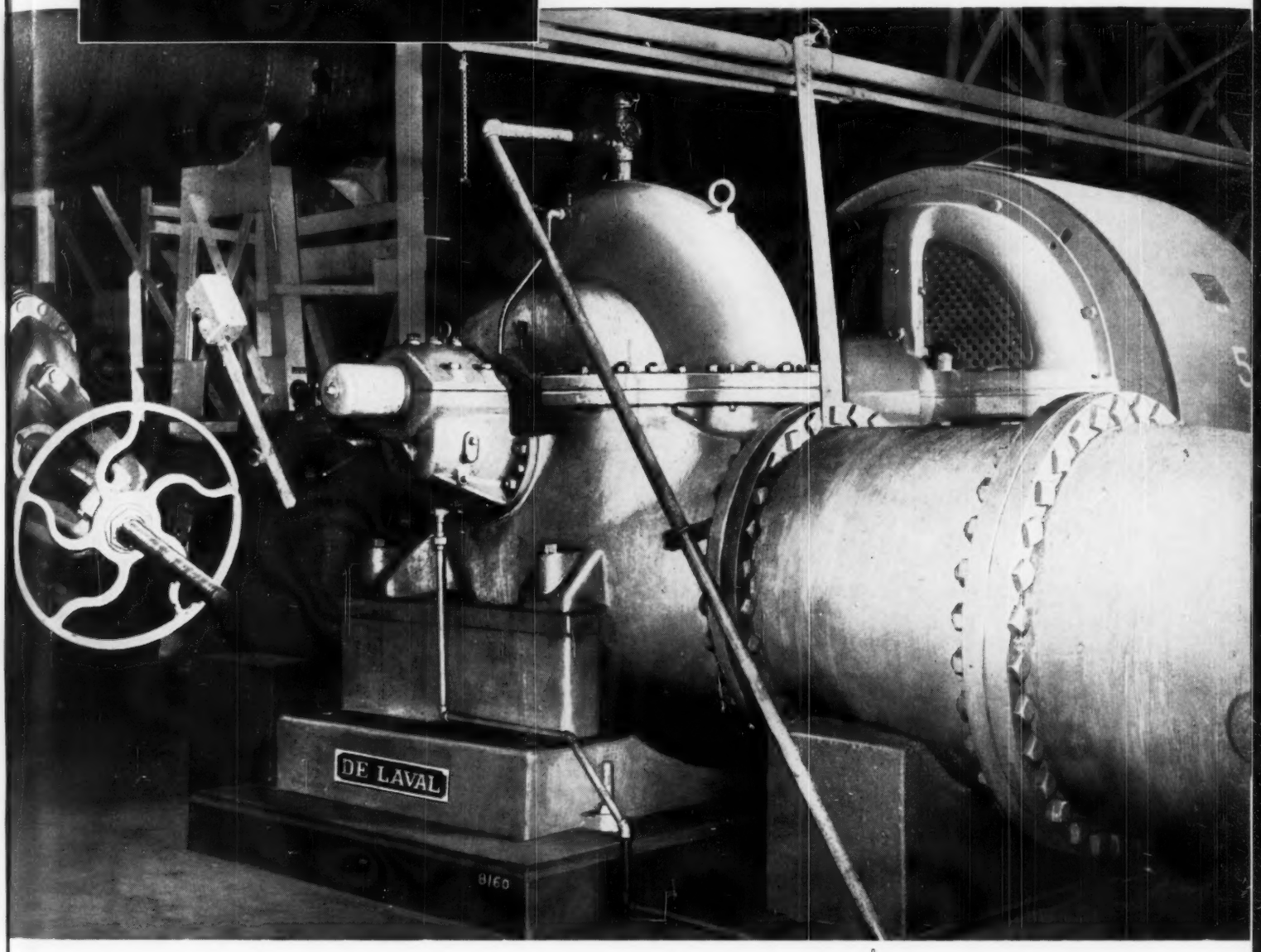
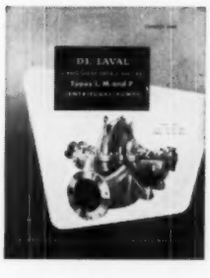
CENTRIFUGAL PUMPS

in service since 1911 at Inland Steel Co.



De Laval Centrifugal Pumps have a record of dependability at the Inland Steel Co., which goes back forty-five years. In that time, De Laval has supplied this major producer with pumps for practically every steel mill service—*more than 75 units in all.* The photograph shows one of the largest De Laval pumps on the line at the East Chicago, Indiana plant of Inland Steel. The unit delivers 20,000 gpm at 120 ft head.

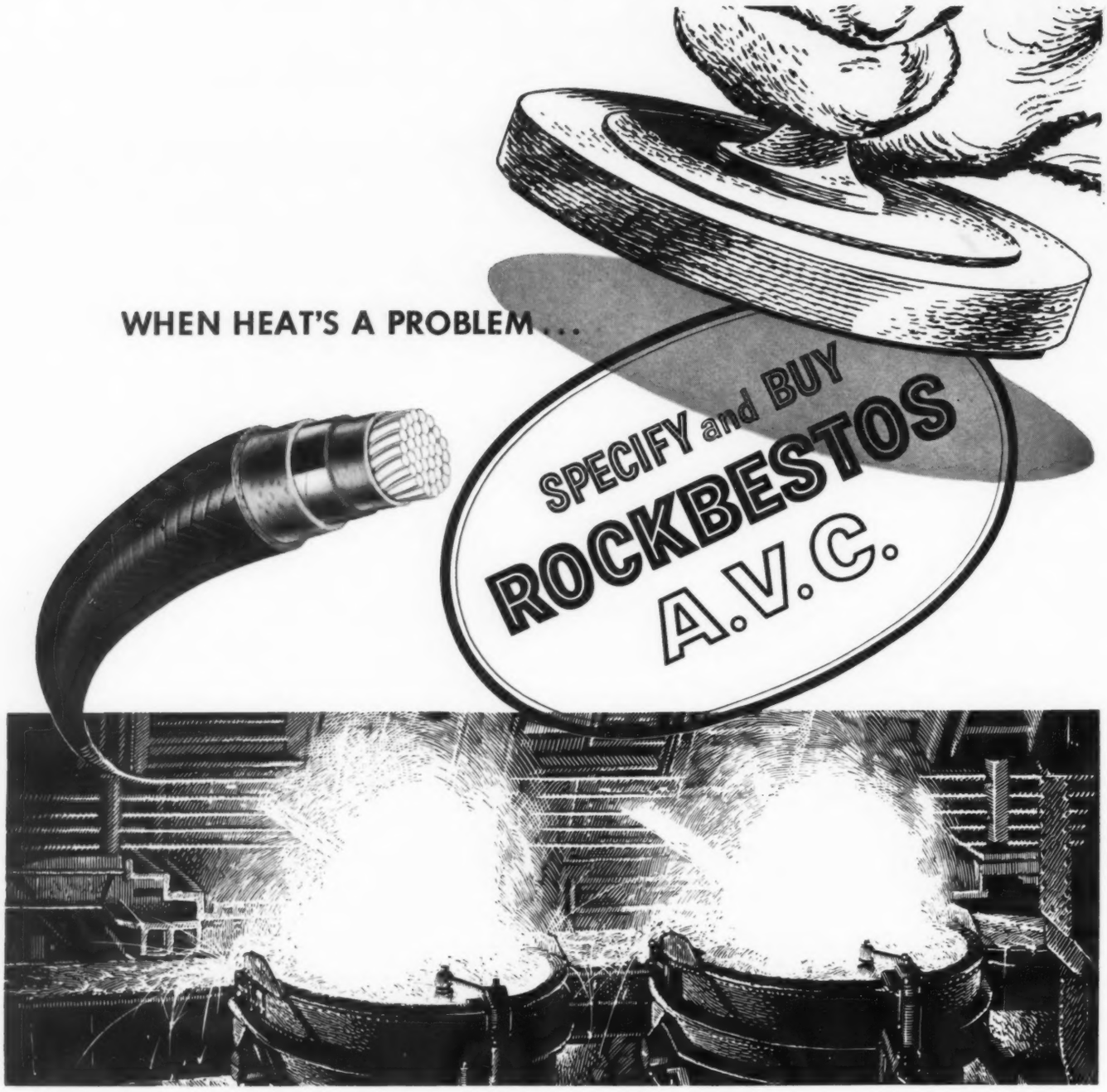
De Laval Centrifugal Pumps are available for a wide range of applications in all types of metal-working plants. Types L, M and P single stage double suction pumps can handle capacities from 1,000 to 20,000 gpm and heads to 350 feet. Larger De Laval units of any capacity to meet any requirement for steel mill service are available.



Send for Bulletin 1004 giving performance and application data.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
870 Nottingham Way, Trenton 2, New Jersey



WHEN HEAT'S A PROBLEM . . .

SPECIFY and BUY
ROCKBESTOS
A.V.C.

Steel Mill and Foundry "hot spots" provide one of industry's worst torture chambers for wire and cable. Heat, overloads and corrosive fumes combine to kill ordinary cable quickly.

Don't take a chance on ordinary cable for troublesome "hot spot" applications. *Specify and use Rockbestos A.V.C.*

This superior AVA cable, with asbestos, varnished cambric insulation, takes temperatures up to 230°F, assuring continuous operation in hot spot applications, provides greater current carrying capacity for increased and new loads.

When you *specify and buy Rockbestos A.V.C.*, you reduce your electrical maintenance and construction costs . . . you get years more dependable service.

Write now for the new Rockbestos RSS-88 to help you *specify and buy Rockbestos A.V.C.*

ROCKBESTOS PRODUCTS CORPORATION
NEW HAVEN 4, CONNECTICUT

NEW YORK • CLEVELAND • DETROIT • CHICAGO • OAKLAND
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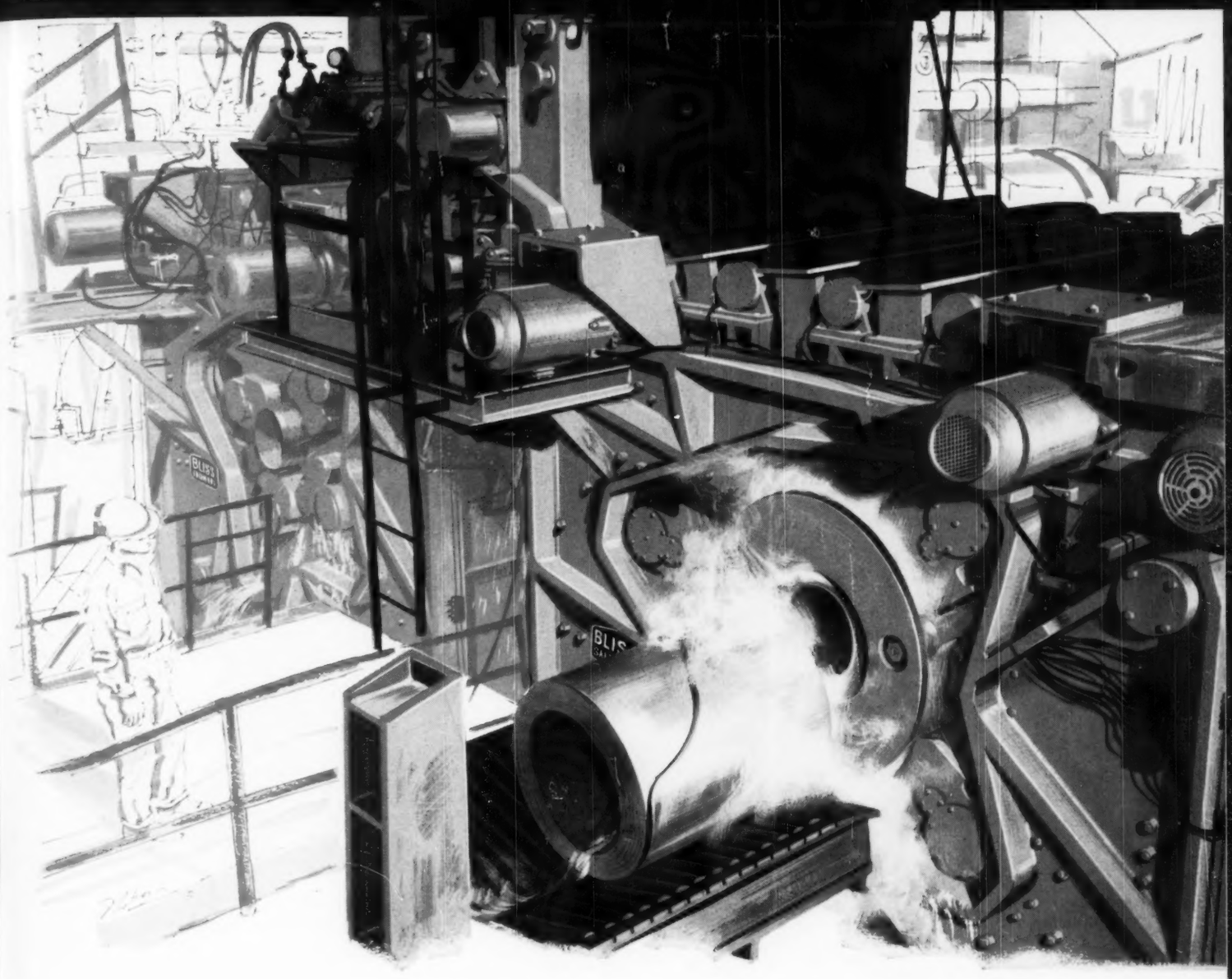
ROCKBESTOS A.V.C.

THE SUPERIOR A.V.A. CABLE



J & L finds a thrifty way to equip a mill with new downcoilers

Not long ago, the 96" hot strip mill at Jones & Laughlin's Pittsburgh Works began to show need for coiler improvements. Bliss Rolling Mill engineers were called in to see what could be done.

After analyzing the situation, they determined that parts of the existing coilers could be retained for use with the Bliss Downcoiler principle. Bliss then performed the task of special design and "field tailoring" to insure improved functional operation.

Today, J & L has the equivalent of a pair of brand new downcoilers, complete with new housings, blocker rolls, stripper mechanisms, roller tables, guides and pinch roll units. The new coilers can handle 30,000 pound coils up to 94" wide.

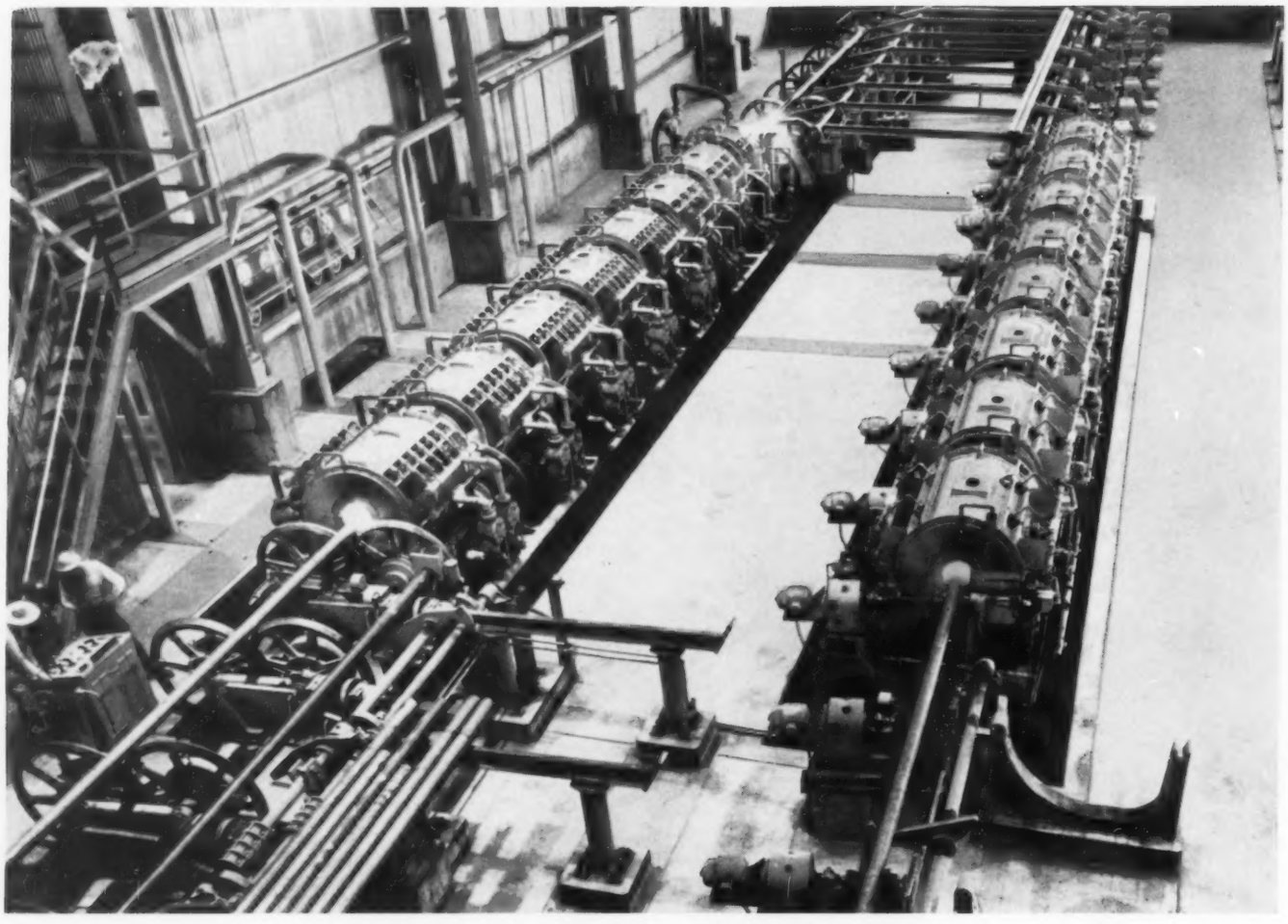
This particular installation is typical of the Bliss Rolling Mill Division's versatility and open-minded approach to a customer's problem. It's easy to learn more about what they have done and can do... just write us today for a free copy of our 84-page Rolling Mill Brochure, Bulletin 40-B.

BLISS
SINCE 1857

100 years of making metal work for mankind

E. W. BLISS COMPANY, Rolling Mill Division, Salem, Ohio

Subsidiary: The Matteson Equipment Company, Inc., Poland, Ohio



Overall view of hardening and tempering lines at C F & I. Heating and quench line (left), tempering line (right). Eight barrels per line.

SELAS processing helps C F & I produce tougher seamless oil well casing

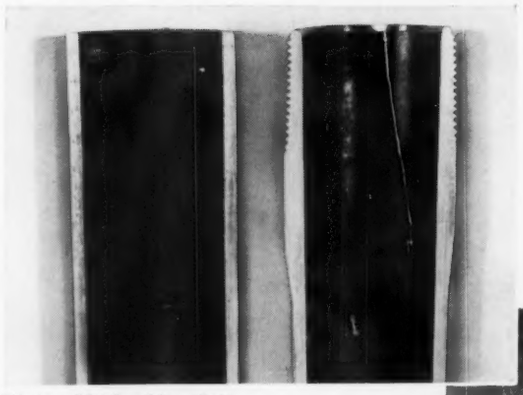
Selas Gradiation® barrel-furnace lines for the short-cycle heating of seamless pipe to be used by the oil industry offer these demonstrable advantages: relatively small floor space; high degree of controllability since each barrel furnace is an entity; extremely rapid heating; formation of little or no scale. Using this continuous, in-line Selas Gradiation method, API Grade N-80 requirements are met without alloy additions or cold working.

Of special significance in a fast-changing economy is the fact that individual furnace units can be added to increase capacity; production schedules are flexible since these furnaces take only an hour or less to heat up after a shut-down.

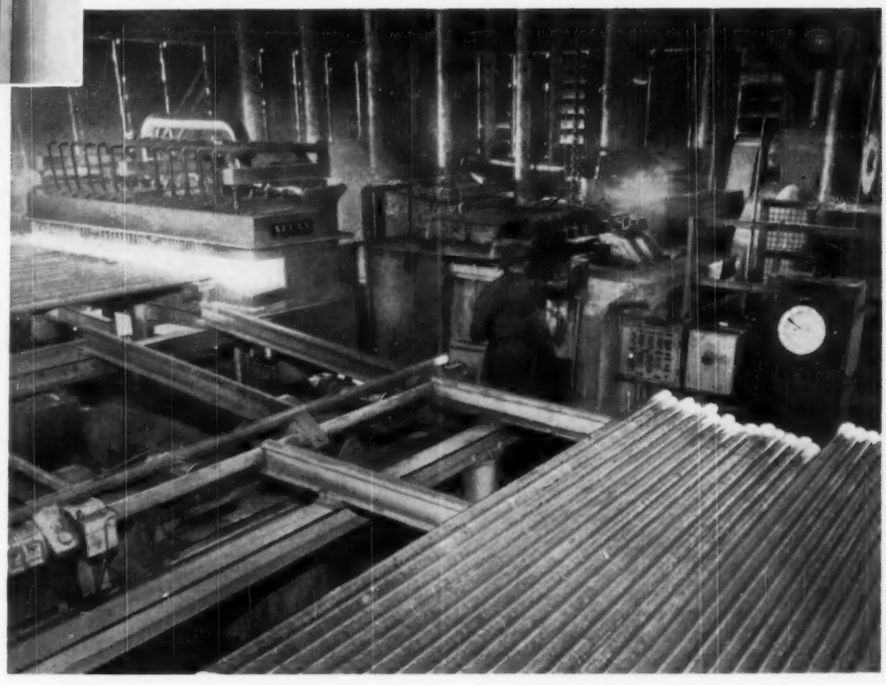
At Colorado Fuel and Iron Corporation's Pueblo plant, Selas short cycle hardening and tempering is providing the required yield strength at lower tensile strength —resulting in a tougher, more machinable product*. Tubing and casing with a minimum of 80,000 psi yield strength, 100,000 psi tensile strength—and at least 15% elongation—is produced continuously, automatically. Before treatment, the rolled tubing has a yield strength of 40,000-50,000 psi and a tensile strength of 60,000-80,000 psi.

Both Selas lines consist of eight small, radiant gas-fired barrel furnaces which operate at high temperatures—well above the tubing's peak temperature—to achieve high transfer rates. Casing enters the heating-quenching line (the left leg of the Ω-shaped installation) and, fol-

* Send for data sheet on effects of higher yield:tensile strength ratio.



Western Metalworking photo



Before and after upsetting and threading oil tubing ends at C F & I. Tubing ends are heated to 2300°F in Selas furnace at left in lower photo. Tubing wall is .190 in. to .217 in. thick before upsetting in machine shown at right, which increases wall thickness 50% for subsequent threading.

lowing rapid heat and quench is automatically transferred to the tempering line. In both the hardening and tempering lines, the casing is rotated to achieve consistent metallurgical uniformity and straightness. The tempering line is synchronized, in terms of forward speed and thermal capacity, with the hardening line. The entire operation is automated, thus producing material less subject to human error.

Additional economies result from decreased handling in heat treatment, fewer operators, reduced straightening, improved machinability and threadability. Surface decarburization is reported to be negligible; scaling is minimized . . . even though no specially-prepared atmosphere is used. From a maintenance standpoint, the small, individually-controlled furnaces are simple to overhaul, downtime is minimized.

An important part of the C F & I production line is a slot-type Selas furnace which heats tube-ends for upsetting prior to threading. As each tube-end is fast-heated to 2300°F, the tubing automatically moves down the handling table to the upsetting machine. The precision of heat placement insures that only the tube end area to be upset actually is heated.

This same principle of Selas fast, continuous heating also is being applied to heating for sizing and to normalizing welded tubing. Today, when operational savings are more important than ever, Selas short-cycle processing can reduce costs of producing high quality seamless or welded tubing and pipe.

For more information, address Dept. 44, Selas Corporation of America, Dresher, Pa.

Gradiation is a registered trade name of Selas Corporation of America.

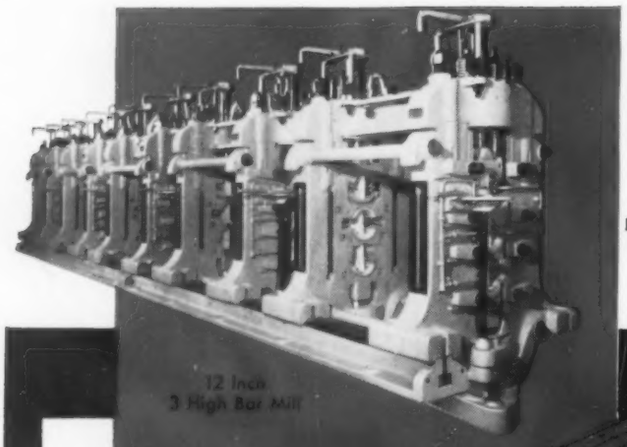
SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

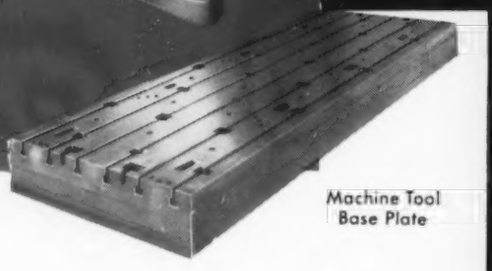
Heat and Fluid Processing Engineers
DEVELOPMENT • DESIGN • CONSTRUCTION

Rolls and Rolling Mill Equipment

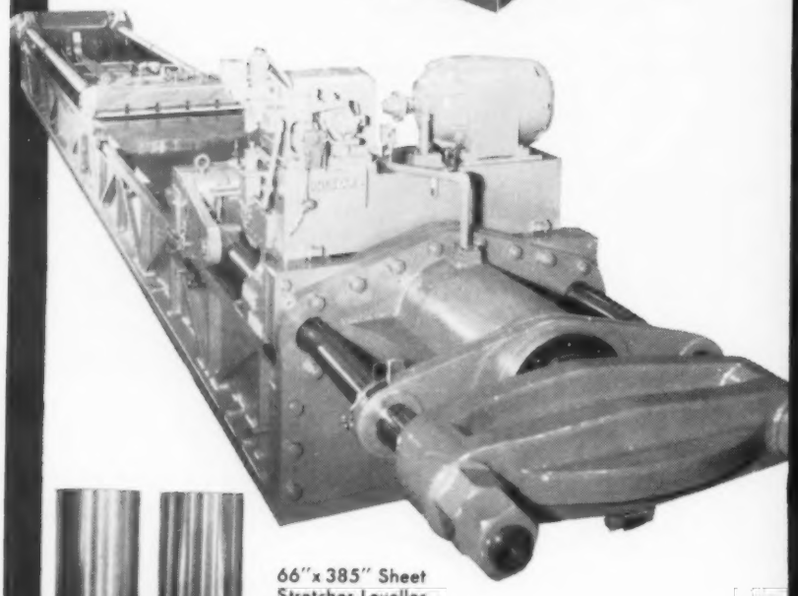
The Mark of Quality

the red circle is your guarantee

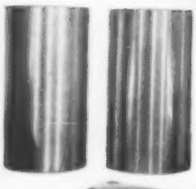




Machine Tool Base Plate



66"x 385" Sheet Stretcher Leveller



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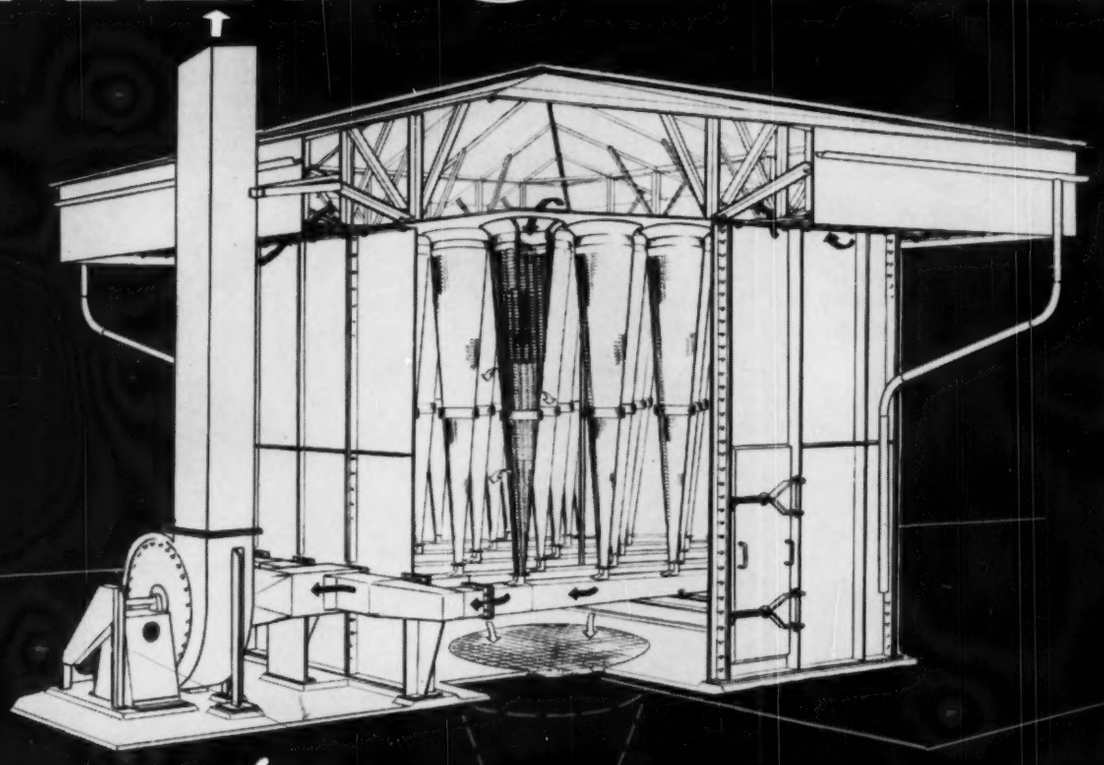

Checks FAN BLADE CUTTING AT INLAND STEEL

Blade erosion in Turbo-Blowers is extremely expensive. Atmospheric air in a steel plant contains a large amount of abrasive particles that can be efficiently removed by an Aerodyne Dust Separator that combines

- **Low installation cost,**
- **Low draft loss,**
- **Small space requirement,**
- **Negligible maintenance cost,**
- **High efficiency for abrasive particles.**

The 125,000 CFM Aerodyne at the Inland Steel Company, Indiana Harbor Plant, East Chicago, Indiana, recovers 100-200 pounds of dust every week and blade erosion is cut to a minimum.

Perhaps you, too, are having blade-cutting problems on the blowers supplying air to your blast furnaces? Ask to have one of our engineers call to discuss the problem.

THE GREEN
POWER AND PROCESS PLANT EQUIPMENT

FUEL ECONOMIZER CO., INC.
BEACON 3, NEW YORK
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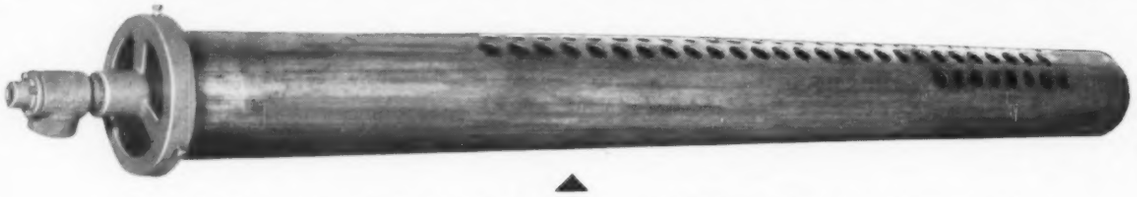
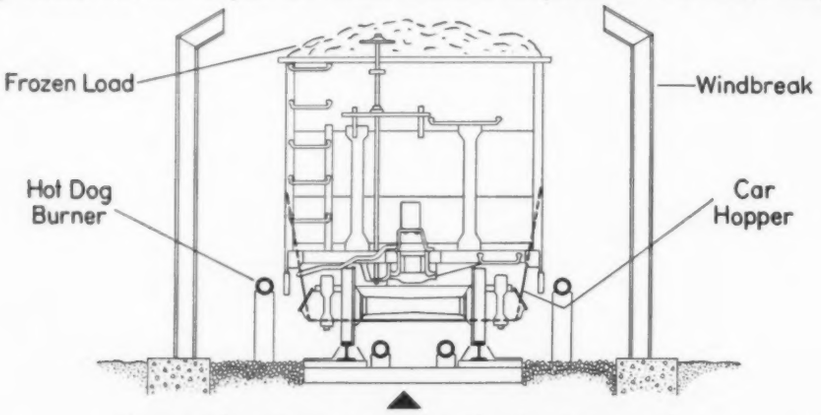
CAR THAWING UNITS
by NORTH AMERICAN



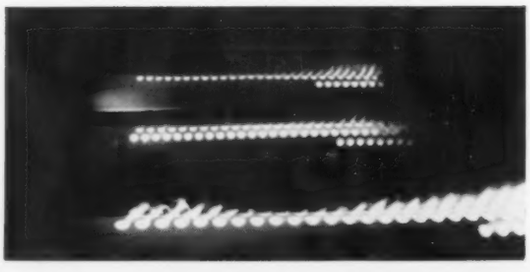
"Hot Dog" Car Thawing Units include a perforated alloy radiant tube, burner, and valves. They heat both bottoms and sides of hopper cars efficiently by both radiation and convection. Note the simple but heavy cast iron construction that assures long trouble-free life despite dirt, water, extreme temperatures, and rough usage.



Suggested positions of four Car Thawing Units, windbreaks, piping, and controls, relative to a hopper car.

"Hot Dog" Car Thawing Units are located between the tracks at track level and 3' outside each rail just above the journals.

Car Hopper in Position over Perforated Radiant Tubes. Journal bearings (right) do not become overheated.



Three "Hot Dogs" in Operation. Note rails between first and second and beyond third tube.

For engineering information consult your nearby N.A. office or write for Bulletin 5854.

NORTH AMERICAN COMBUSTION Since 1917

The North American Manufacturing Co.
COMBUSTION ENGINEERS
CLEVELAND 5, OHIO

58.54

1/666th of an ounce ...or... 7 tons

What's the size of the smallest bearing you order in the course of a year's time? In contrast, what is the size of the largest bearing you order?

Regardless of how small...or...how large may be the bearings you require--you can get immediate delivery on *everything* you need from Berry Bearing Company.

And this you can depend on. Because, in Berry's inventory of well over 50,000 bearings, bearing specialties, and transmission appliances--ALL sizes are regularly carried in stock. Every item is ready for delivery in approximately 27 minutes --*anywhere* in the Chicagoland industrial area.

Thus, when you want a bearing that is so minute that it is near-microscopic...or...so large that it is Gargantuan...or... any size in-between, phone Berry--bearing headquarters since 1920. You'll get *immediate delivery* on every order.

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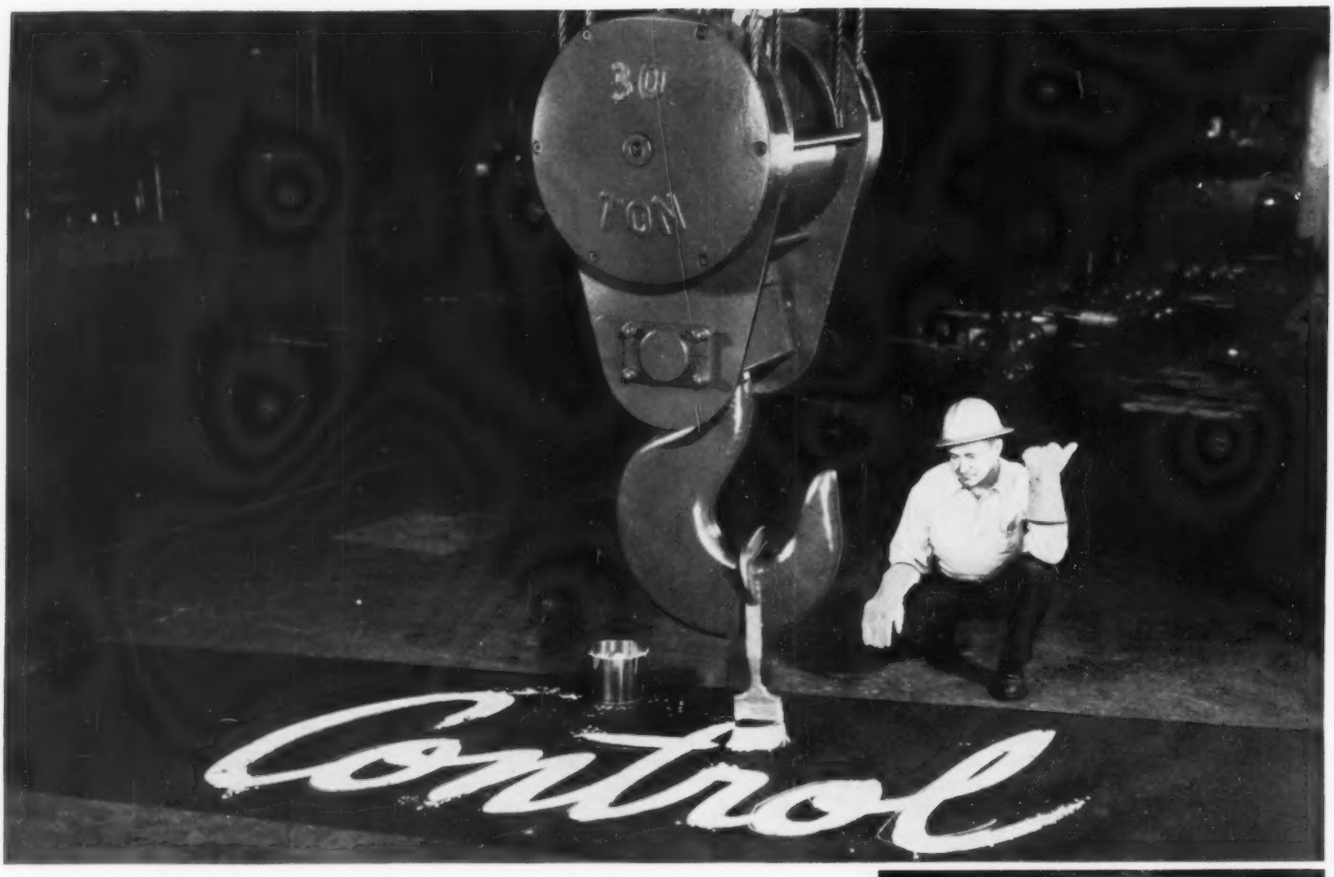


So Precise

you can write your name with a "Shaw-Box" Crane

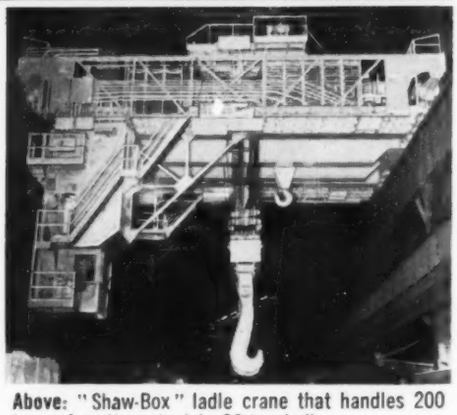
You may never write your name with a paint brush clamped to a crane hook. We did it at our factory in Muskegon to prove you get absolute control of travel, traverse, lifting and lowering with a "Shaw-Box" Crane.

Total crane control demands more than sensitive controllers and the skill of the man in the cab. Every mechanical, electrical and structural component must contribute to precision operation. That is why "Shaw-Box" Cranes give full satisfaction in every respect.

Turn to Shaw-Box for the crane you want

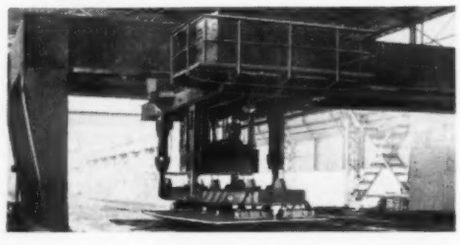
Shaw-Box produces cranes of *any* type and capacity to AISE standards or your own. Your particular materials handling problems come first. No traditional concepts of design hamper the development of the modern crane you want and must have for top efficiency, easy maintenance, power economy and complete safety.

Call in one of our engineers. He will gladly discuss your specifications and our standard AISE designs for 5 to 500-ton cranes. Your inquiry is invited.



Above: "Shaw-Box" ladle crane that handles 200 tons of molten steel in 90-ton ladle.

Below: "Shaw-Box" plate handling gantry with lifting magnets.



58 K-3

"Shaw-Box"® CRANES

MANNING, MAXWELL & MOORE, INC.

SHAW-BOX CRANE & HOIST DIVISION

388 W. Broadway • Muskegon, Michigan

Builders of "SHAW-BOX" and 'LOAD LIFTER' Cranes, 'BUDGIT' and 'LOAD LIFTER' Hoists and other lifting specialties. Other Divisions produce 'ASHCROFT' Gauges, 'HANCOCK' Valves, 'CONSOLIDATED' Safety and Relief Valves, and 'AMERICAN' and 'AMERICAN-MICROSEN' Industrial Instruments.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

APPLETON type "ECC"

explosion-proof, dust-proof cable connector

(CLASS I, GROUPS C and D; CLASS II, GROUP G)

UL approved

A factory-sealed, explosion-proof connector used between a portable extension cord and an explosion-proof unilet or housing

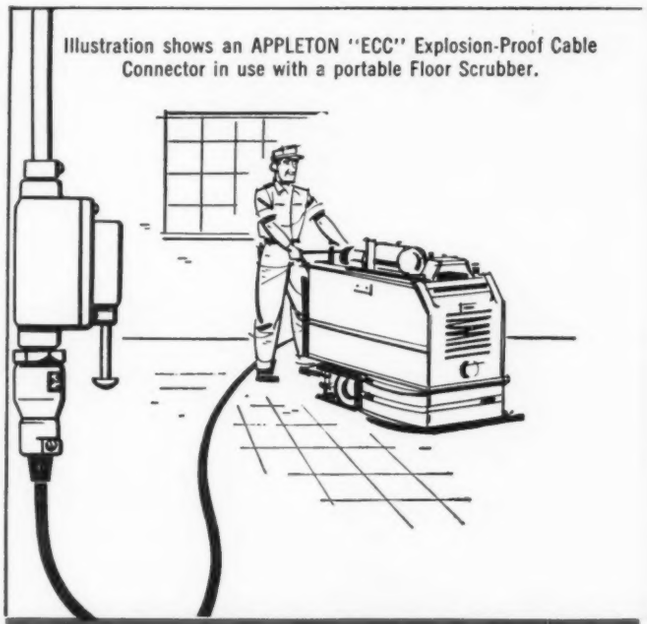


Illustration shows an APPLETON "ECC" Explosion-Proof Cable Connector in use with a portable Floor Scrubber.

From its rugged aluminum housing which withstands years of extreme rough usage, to its lead wires protruding 12" from the body for faster, easier splicing, this APPLETON "ECC" Connector has every desirable quality feature.

The current carrying lead wires for example, are solidly moulded into the connection blocks: can't work loose under vibration. An auxiliary cord clamp is provided to prevent strain on the wire connectors resulting from sudden tugs on the cord. This clamp fastens tightly by screw pressure on a tapered rubber bushing in the form of a sleeve... effectively sealing the cord entrance. Three pressure-type solderless lugs on the load end of the "ECC" allow quick connections to be made with Type S Rubber-Covered Cord in ranges of #18 to #12, AWG. The grounding connector is plainly identified with a letter "G" on the block. Only the APPLETON Type "ECC" Explosion-Proof, Dust-Tight Cable Connector offers so many worthwhile features for such an economical price.

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Also Manufacturers of:

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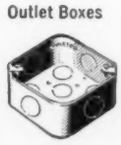

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Here's the secret. Unique advanced tubular construction. Every positive plate packs more power. So you get greater battery efficiency—more power in the same size to fit your present trucks.

With the new Exide-Ironclad Batteries now available, your present trucks can work 25% to 56% longer than with batteries you have bought in the past. Now electric industrial trucks can do more work per shift, work longer, cost less than ever to own and operate. Only Exide batteries offer the twin advantages of more power and longer life. Find out just how much you can gain. Call your nearby Exide office. Or write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

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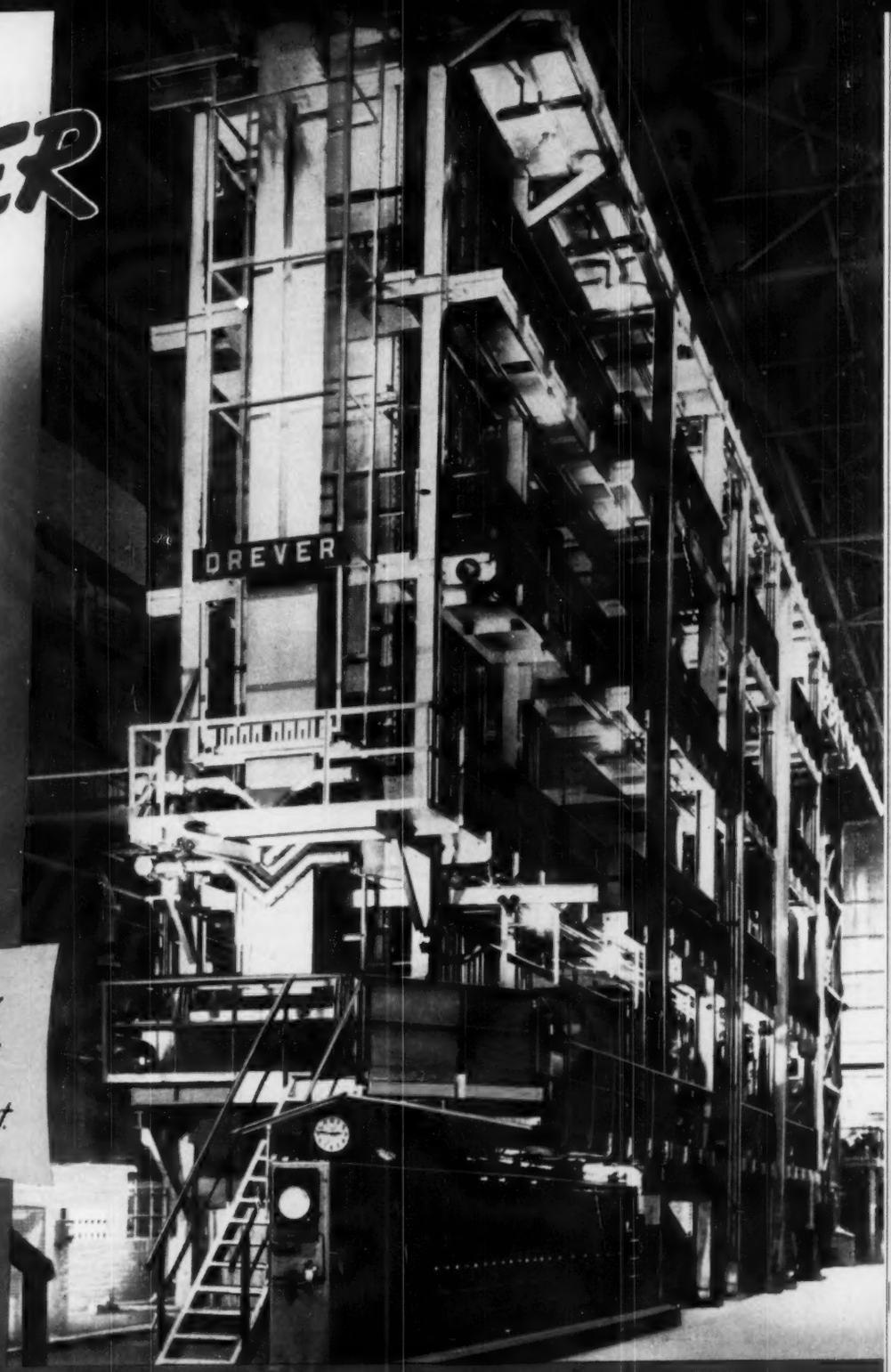
Continuous STRIP ANNEALING FURNACE LINE



Delivery end of furnace for low carbon tin plate strip installed in a large Canadian steel plant.

This furnace has an installed electrical input in heating and soaking zones of 3000 KW for a rated production of 37,000 lbs/hour on .0099″ x 33″ wide strip running at 550 FPM.

Furnace equipment is designed to handle strip in thicknesses from .0075″ to .020″ in widths varying from 19″ to 38″.

HNX atmosphere gas is used to purge the furnace.

DREVER COMPANY

..... RED LION ROAD and PHILMONT AVE., ... BETHAYRES, PA.

BEARINGS OF ALCOA ALUMINUM OUTPERFORM ALL OTHER SOLID-WALL BEARINGS...

Only aluminum has the combination of advantages demanded for the best all-around performance of solid-wall bearings. Alcoa® Aluminum alloys have the unmatched combination of these advantages to give you bearings that:

Withstand heaviest loads . . . Solid aluminum bearings withstand loads up to 10,000 psi on projected area.

Run cooler . . . Aluminum is the best heat conductor among bearing materials, and this means cooler running bearings . . . as much as 20° cooler by actual test.

Conform readily . . . Aluminum has good ductility, conforms readily to misaligned shafts or nonparallel pins and thus reduces unit loading for longer bearing life.

Have ideal embeddability . . . Aluminum embeds particles far better than bronze, but not as deeply as babbitt. Dirt particles roll out easily and are trapped by the filter.

Resist corrosion . . . Aluminum bearings do not corrode . . . are unaffected by additives in oils, need no protective coating.

Have design flexibility . . . The structural properties of aluminum give great design flexibility, ease of machinability.

Why not investigate the use of solid aluminum alloy bearings for your equipment? Call your nearest Alcoa sales office or write to Aluminum Company of America, 1983-D Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM BEARINGS

Your Guide to the Best in Aluminum Value

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Alternate Monday Evenings

NEVER OVERLOOK THE DANGER OF EXPLOSIVE DUST...

Some of the most disastrous explosions in industrial history occurred through the ignition of dust suspended in plant atmosphere—some of them dusts which were thought to be perfectly harmless. *Until they exploded.*

The moral is clear: If you can see quantities of dust in your plant, *it's dangerous.*

Crouse-Hinds dust-tight* Condulet equipment seals off electrical sparks and prevents ignition of air-suspended dusts. It is designed to minimize the accumulation of dust on outer surfaces. As an added precaution, it is built to operate at a temperature below dust-ignition points *even when blanketed with dust.*

The new Crouse-Hinds "Hazard Finder" will help locate the hidden probabilities of electrically-ignited explosions in your plant. It reflects, in non-technical language, the latest findings of the National Fire Prevention Association for thorough control of electrical explosion hazards. Just clip coupon below.

*Dust-ignition-proof.

Crouse-Hinds Dust-tight Lighting Fixture

Crouse-Hinds Dust-tight Panelboard

● CONDULET® ELECTRICAL EQUIPMENT — More than 15,000 items in dust-tight, explosion-proof or conventional construction . . . including rigid conduit fittings, lighting fixtures, switches, plugs and receptacles, motor controls, pilot lights, push-button stations, and other process control components.

CROUSE-HINDS COMPANY
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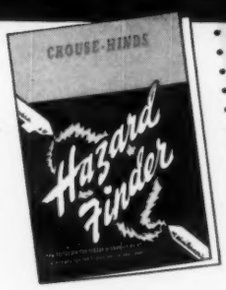
...nd coupon today for handy new HAZARD FINDER!

Contains 13 check questions to which every management team should know the answers! Each answer evaluated in accordance with National Electrical Code requirements.



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1205 Wolf St., Syracuse 1, N. Y.

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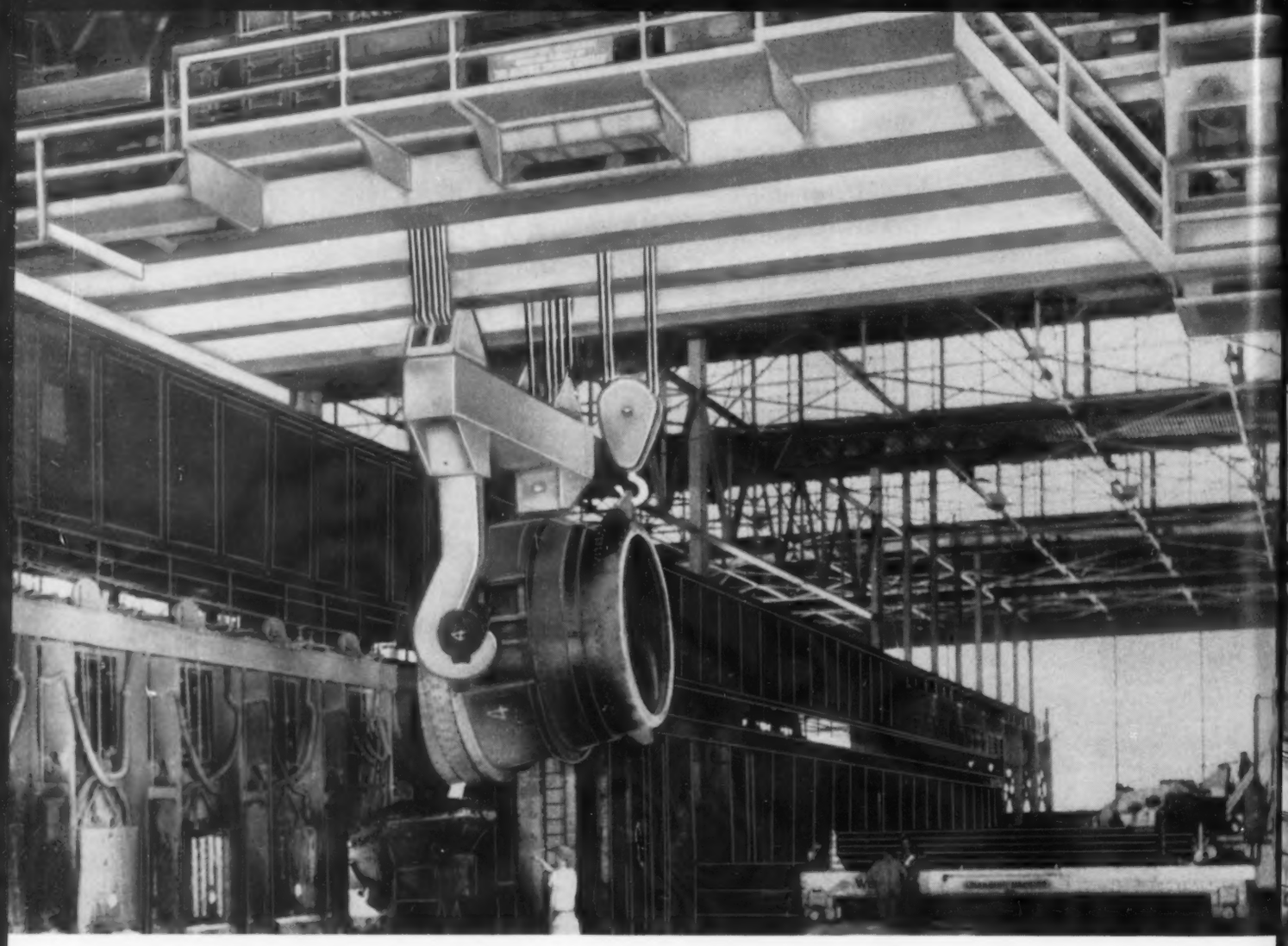
Zone_____ State_____

CRANES FOR MODERN



• The main consideration in modern open hearth production is to cut material handling costs while increasing production and efficiency. Alliance engineers' knowledge of operating problems has played a big role in adapting the world's biggest cranes to these tasks. The newest Alliance units are handling in excess of 500 tons.

The modern electrical control installed on these cranes permits the operator to position the loads with great accuracy. Practically all units are air conditioned and many are equipped with two-way FM radio.

In designing ladle cranes The Alliance Machine Company has always practiced "Safety First" and has pioneered many of today's safety features.

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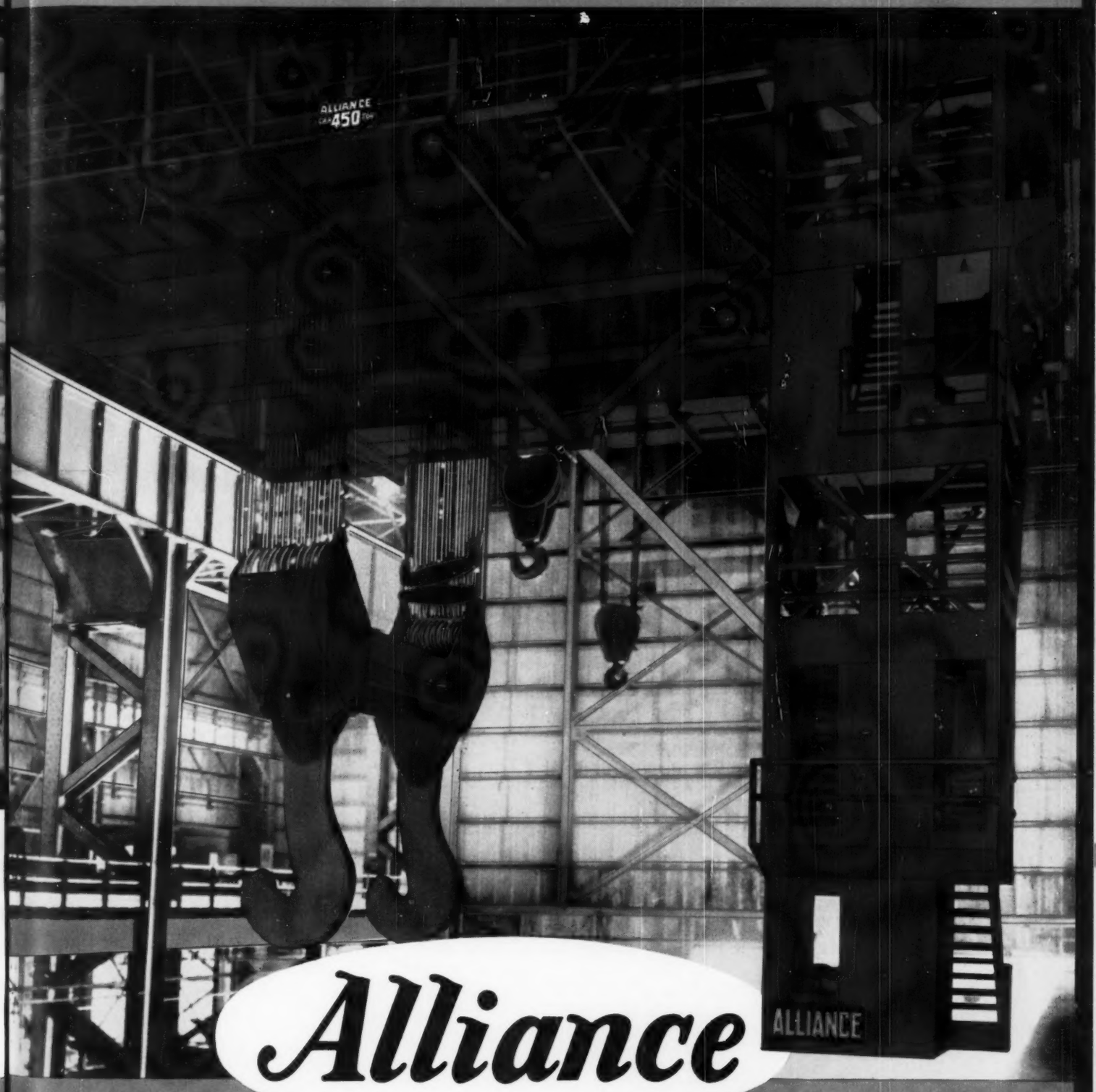
Open Hearths



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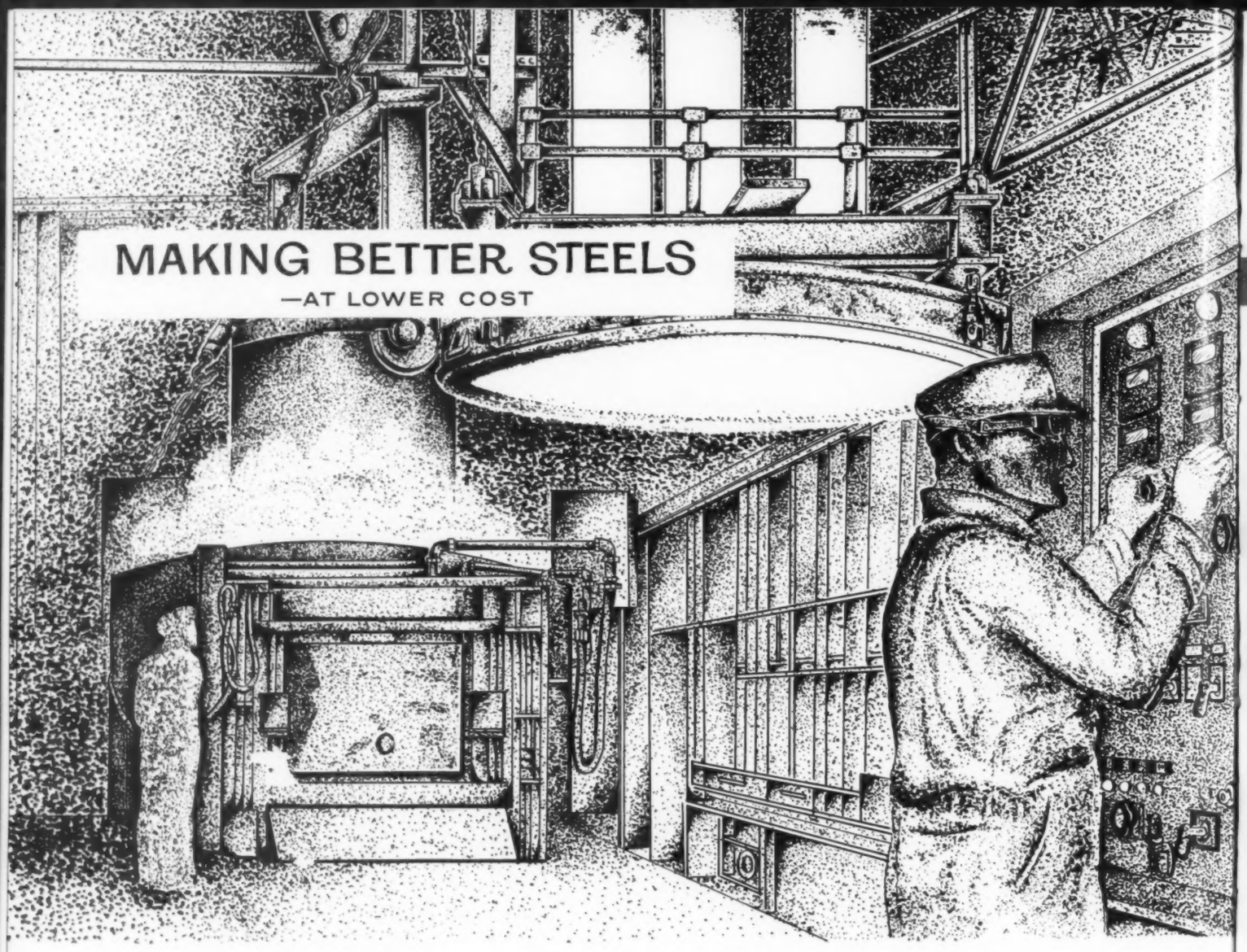

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MACKINTOSH-HEMPHILL DIVISION, E. W. BLISS COMPANY, Pittsburgh 3, Pennsylvania

Cast mill rolls • Johnston cinder pots • rotary tube straighteners • end-thrust bearings • heavy-duty lathes • steel and special alloy castings

Tooling: key to longer roll life between redressings

Most difficult roll turning job done regularly at Mack-Hemp is dressing pipe mill rolls. Turning takes a week or more, with carbide tools reground three or four times per hour.

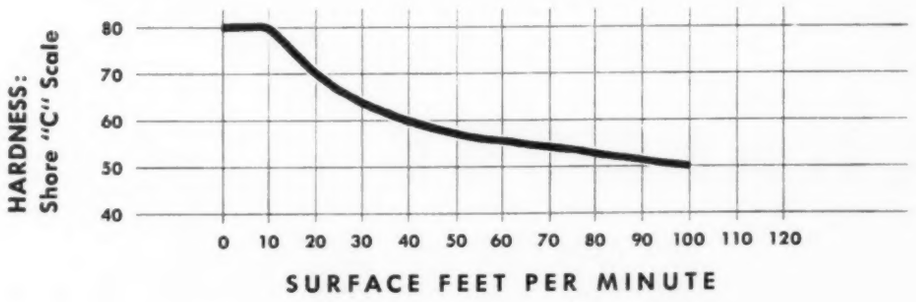
In a very important sense, block lathe turning practice sets the upper limit on the production-per-turn of every rolling mill in a plant. The reason is obvious. If the roll shop won't turn rolls whose hardness is above a certain figure, then the extra wear resistance of these harder rolls can never be brought into play.

In investigating roll shop machining techniques, we've found that many roll shop men are often not fully informed of the remarkable increases in turning speeds, feeds and depths of cut made possible by carbide tools. High speed cutting tools can dress rolls of hardness up to approximately 68 Shore (C scale), but carbide tools can cut harder rolls up to and including pipe mill rolls that are nearly 80 Shore. A set of these extremely hard rolls recently rolled 3500 miles of pipe between dressings!

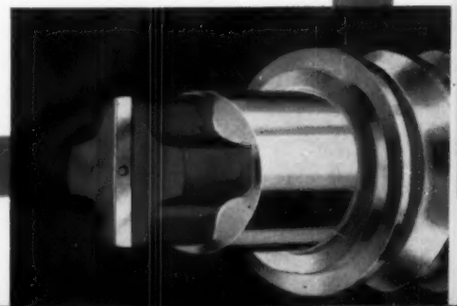
Higher turning costs can pay dividends

At these higher-hardness levels, turning a large roll takes time and care; correct speeds must necessarily be selected and feeds are sometimes reduced to only a few thousandths of an inch. And even with a comparatively low rate of metal removal, the cutting tools must be reground after every few hundred surface feet. Three to four tools are worn out on every roll. *But* . . . the dividends in service life pay for the turning costs many times over.

Since Mack-Hemp specializes in rolls, roll turning and large roll contouring lathes, our experience in these three fields together with our awareness of the high tonnages available from the harder roll grades, helps us to make intelligent recommendations to our customers' best advantage. Suggestion: if you have had difficulty in the turning of hard rolls and want to explore their use in your mills, why not give us a call? Address Mackintosh-Hemphill Division, E. W. Bliss Company, 901 Bingham Street, Pittsburgh 3, Pa.



Cutting speeds (approximate) used by Mack-Hemp's machining department. Feeds and depths of cut vary widely depending on the roll and the power of the lathe available. These speeds are offered simply as a guide and should be adjusted to individual requirements.



MACKINTOSH-HEMPHILL

You get more tonnage from the rolls with the Striped Red Wabblers

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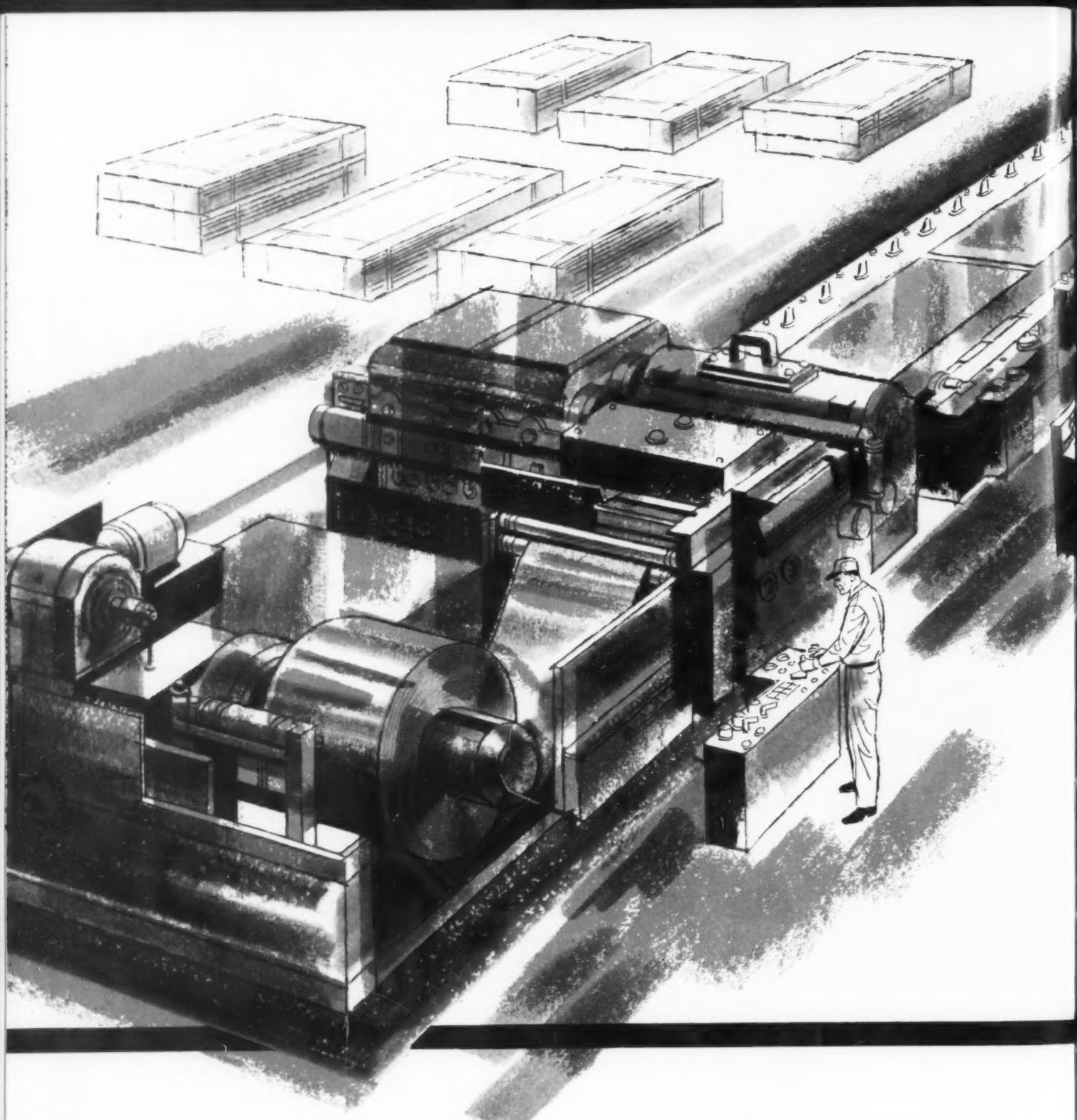
Presses, Rolling Mills, Special Machinery



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from furnace to finish

Advanced, Coordinated Control for your Shearing Line

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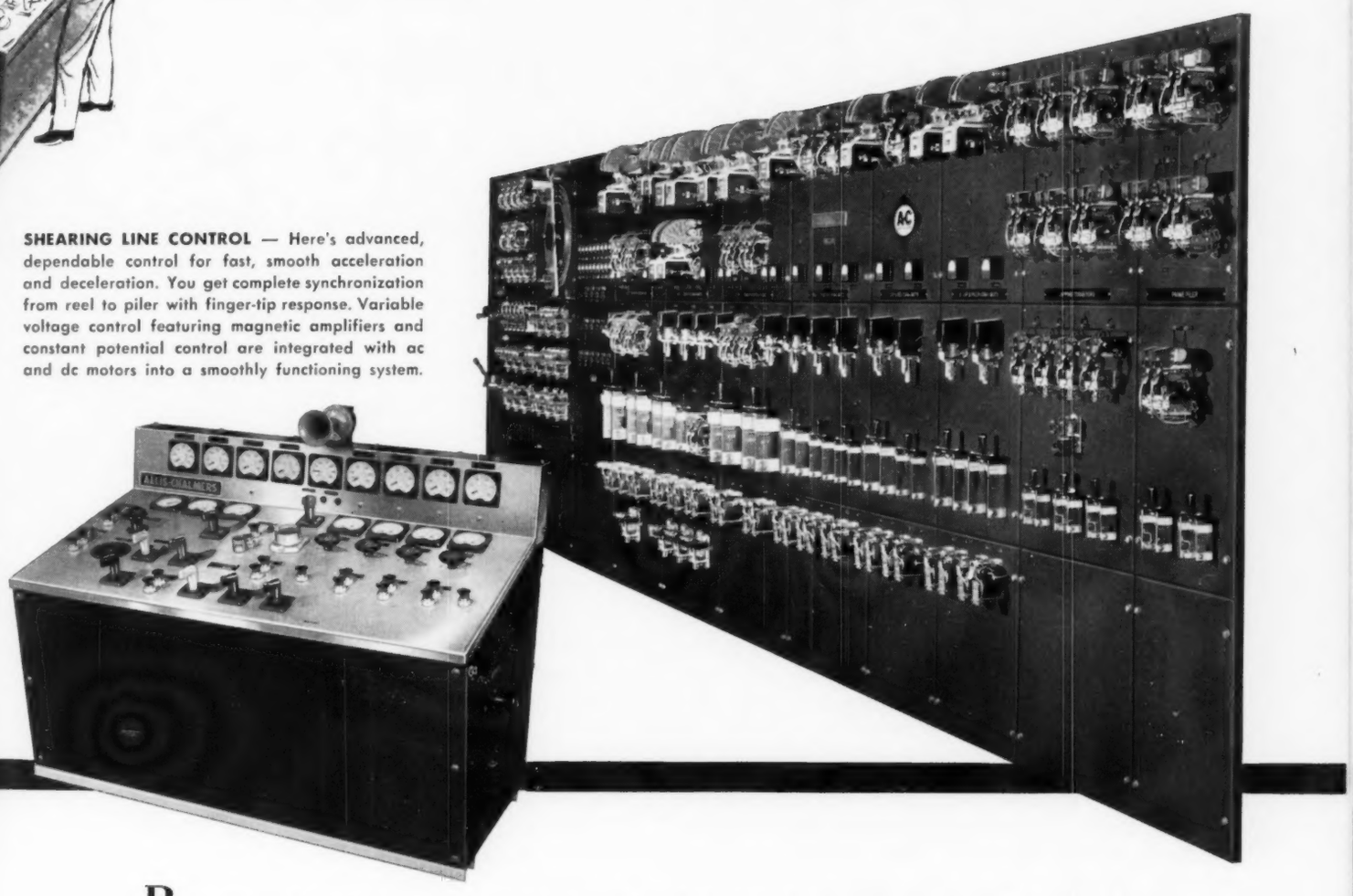

Regardless of your needs, you can get control equipment from Allis-Chalmers designed to meet your specific application. Allis-Chalmers builds control not only for rough, tough furnace and main mill applications, but control to provide the precise coordination required for processing lines and also equipment for accurate regulation and exacting performance of finishing mills.

Special study is given to each application so that control components are properly integrated to provide maximum output with minimum downtime. In addition, Allis-Chalmers has the specialized knowledge to coordinate control throughout your entire mill.

If you want to learn more about control designed to meet your specific mill requirements, call your nearest A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

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A-5513

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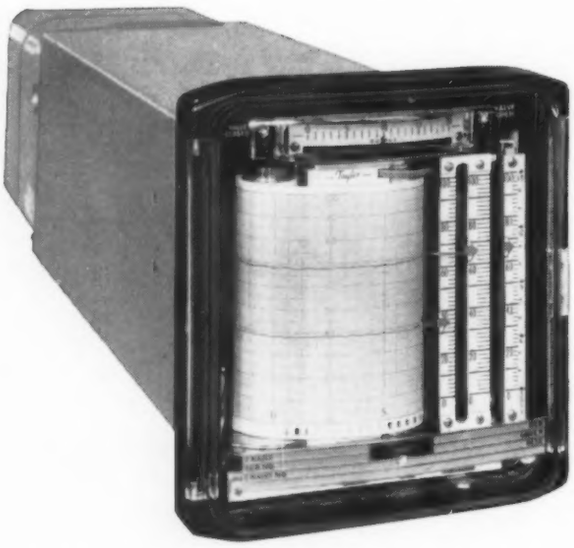
REVOLUTIONARY ACCURACY AND BIG-INSTRUMENT FEATURES



"No other recorder, regardless of size, puts so many features in so little panel space."

Front of Panel Control Settings let you make adjustments easier, quicker, and better . . . *from the front of the panel* . . . while recording! You can clearly see what you are doing, and the results, because the record is continuous.

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Complete Indicating Control Station while recorder is removed. You see the variable. There's no need to shut down the process for instrument service or adjustments. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter, an Automatic-to-Manual switching lever, a Cascade or process-output indicator, and many other features . . . all in a compact case.

"SERVOMATIC" Motor assures lifetime accuracy of pen position. Transmitter signal is received and amplified by individual force-balance servomechanisms. Spring feedback and powerful pneumatic motor give 150 times greater power than normally available for pen positioning.

0.1% Threshold Sensitivity—a new standard of accuracy. Responsiveness to transmitter output is 0.1%, and because of the very small pneumatic displacement of the input capsule, is practically instantaneous.

Optional Alarms. Each SERVOMATIC motor can operate either an electric or pneumatic alarm. Each alarm can be adjusted for one high and one low, or two high or two low operating points.

For further information about this revolutionary new recorder, see your Taylor Field Engineer, or write for **Form No. 98282.** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

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VISION · INGENUITY · DEPENDABILITY

Your NATIONAL TRADE-MARK brush man showed this electroplater how to double brush life!

CLIFF BROWER

Rapid brush wear was limiting generator performance at this busy electroplating plant, says "National" Carbon Brush Man, Cliff Brower. No other industrial brush solved the problem until Cliff suggested a newly developed "National" brush grade.

That was five years ago. Since then not one commutator has been stoned or turned. Brush wear has been even, with no selective action or overheating—even under 20% overloads. This "National" BGX brush grade actually doubled brush life.

Cliff Brower and his fellow "National" Carbon Brush Men have been solving industrial brush problems for years. Their experience and training—backed by "National" *long term brush development*—make them the best consultants on any industrial brush problem.

Call your "National" Brush Man today. Or write National Carbon Company, Division of Union Carbide Corporation, 30 E. 42nd St., New York 17, N. Y.

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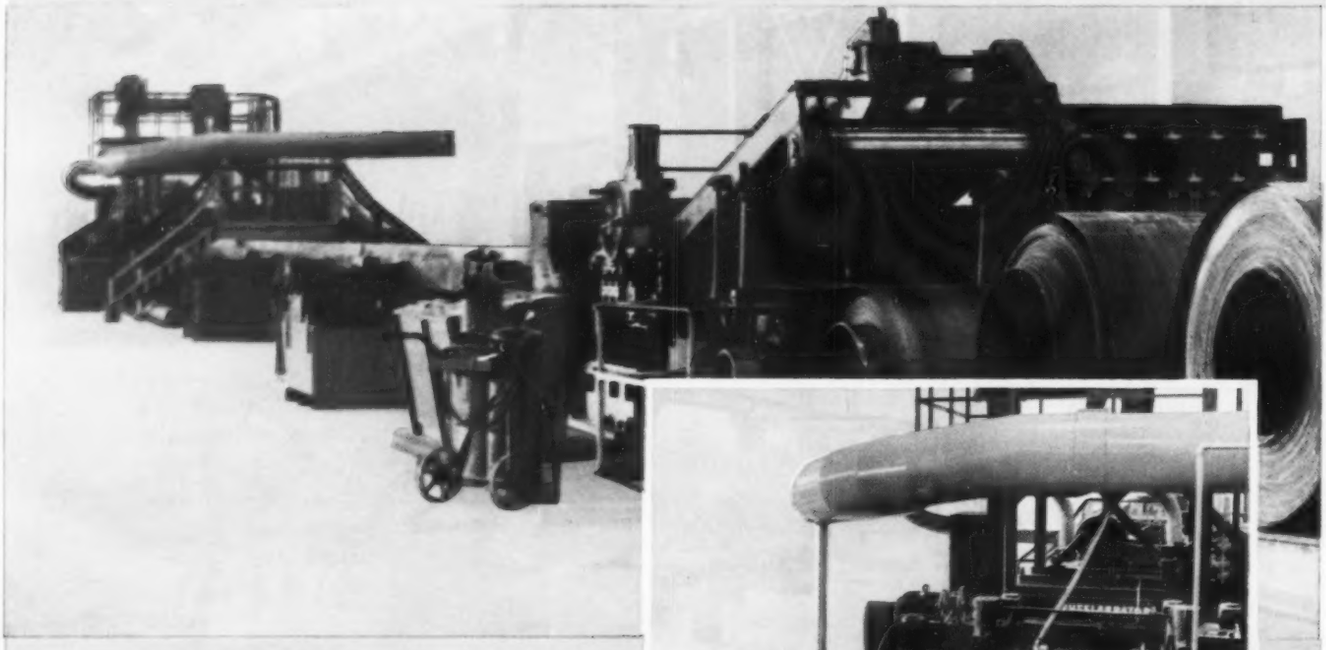

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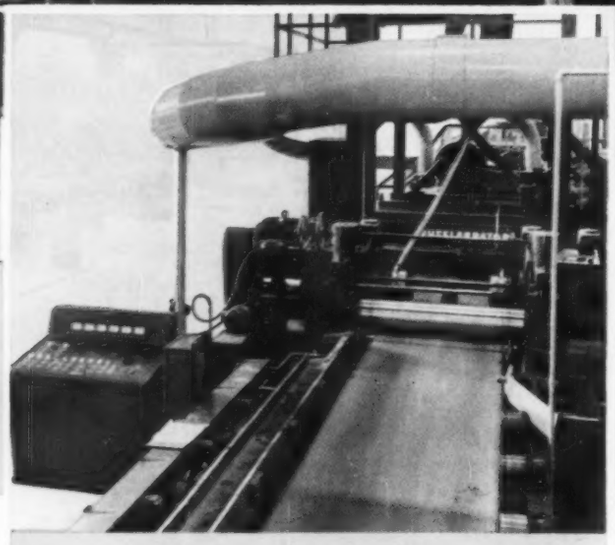

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Stamco has the equipment you need. If you use trimming units, plate shears, slitting units, coil openers, or ANY OTHER SPECIAL steel mill equipment, you will be money ahead if you contact STAMCO. Call or write us today. No obligation.

STAMCO, INC., NEW BREMEN, OHIO, U.S.A.

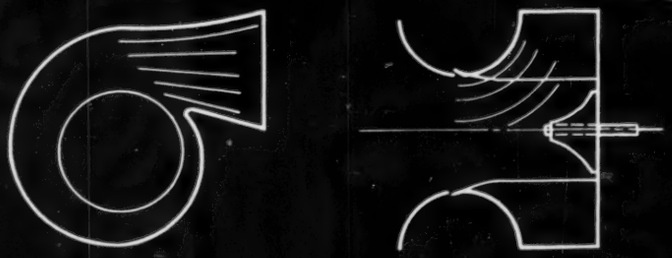
"Buffalo" Type "CR" Radial Blade Fan

Widely-used in rugged steel mill applications, the "Buffalo" Type "CR" Radial Blade Fan is unsurpassed for dependable and long-lasting service under the most severe industrial conditions.

The "CR" is unique in the fact that the same design principles which reduce wear actually increase the efficiency of these husky fans. An engineering refinement of the radial blade principle — plus a new high in streamlining the entire fan, from inlet through wheel to outlet — boosts performance at the same time that it cuts down wear. (See drawings at left.)

Add to these wear-resistant **design principles** the long-standing "Buffalo" tradition of heavy-duty reliable **construction features**, and you have an unbeatable combination of factors contributing to maximum efficiency and minimum wear.

DESIGNED FOR PERFORMANCE UNDER DEMANDING CONDITIONS



Streamlined housing and gradually diverging outlet not only increase static efficiency, but reduce housing wear because of minimum turbulence.

Mating sections of the inlet and wheel flange form a true-half-circle. Resultant smooth air flow further reduces wear and provides peak performance.

Investigate this high performance fan, designed for severe industrial service. Ask your nearby "Buffalo" Engineering Representative for full details on the "CR", or write for Bulletin FD-205.

Every "Buffalo" Fan features the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

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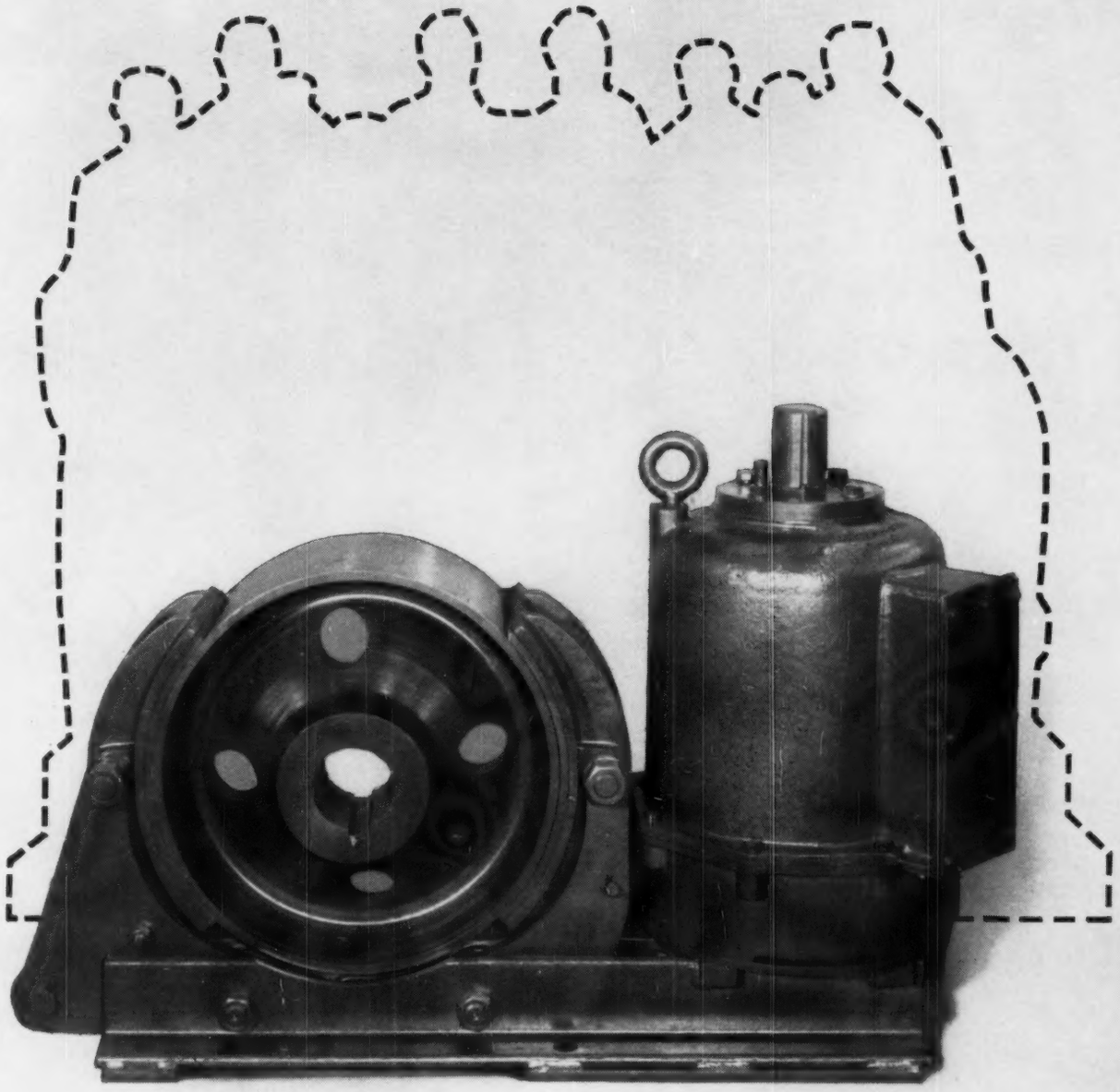

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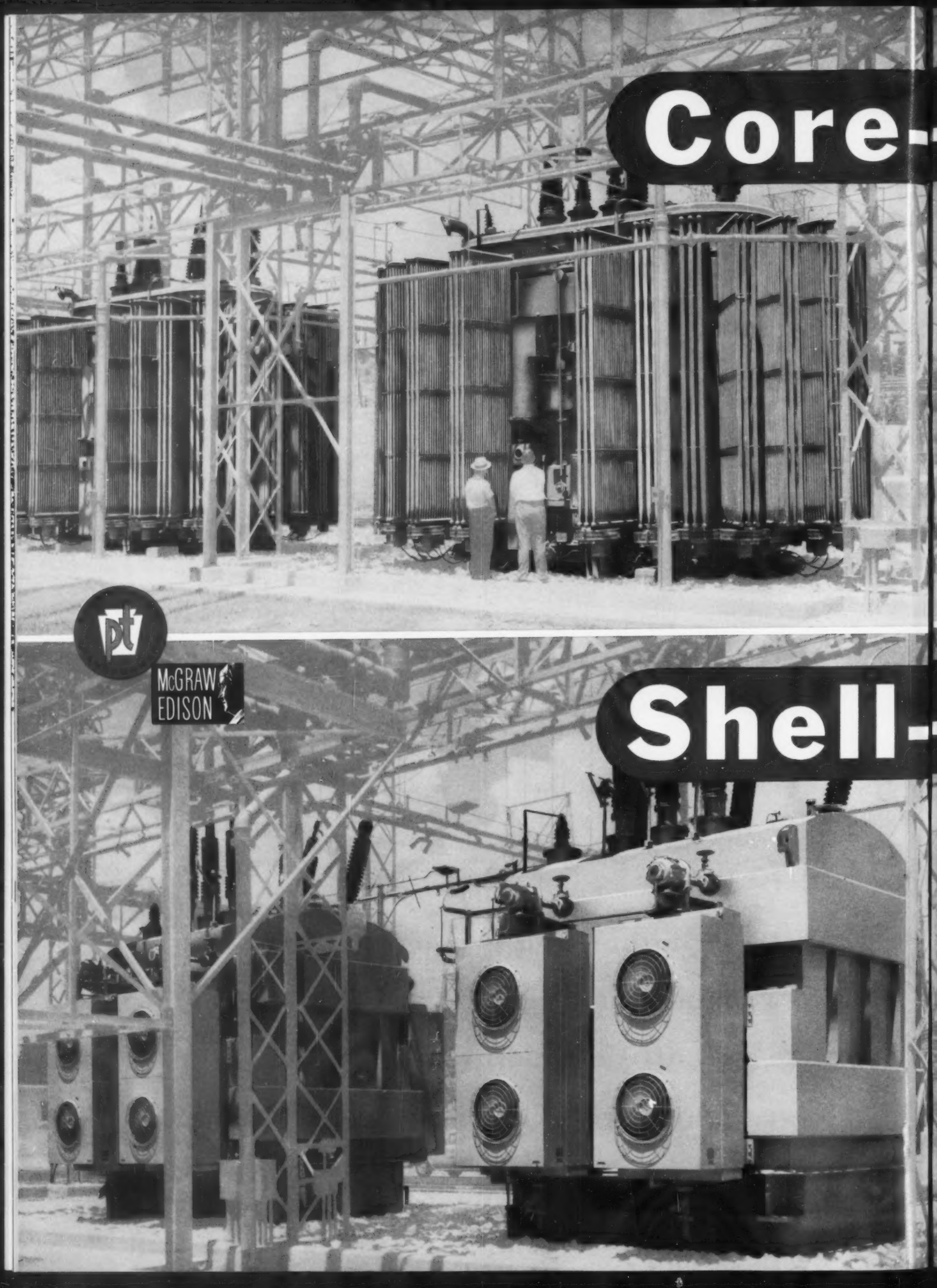
Westinghouse d-c magnetic brakes adjust themselves automatically... save you all this maintenance cost... approx. $60.00 per year per brake.

YOU CAN BE SURE... IF IT'S Westinghouse


Core--
pt
McGRAW EDISON
Shell--

e--form?

Pennsylvania builds both types of power transformers . . . choosing the best design for each application

Pennsylvania Transformer builds *both* core-form and shell-form power transformers because there are inherent advantages to be found in both designs. Whether core-form or shell-form design is best for a given kva and voltage in a particular application depends on such factors as size and weight . . . ease of installation . . . impedance . . . application of insulation . . . method of cooling, etc. In cases where there is no particular advantage to be found in either design, the purchaser's individual preference may prevail.

By taking advantage of Pennsylvania Transformer's wide experience in both core-form and shell-form design, you can be certain that every power transformer installed is the "right" transformer for that particular application. Contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

l--form?

350,000 kva Pennsylvania transformer installation includes both core-form and shell-form Generating Station Units

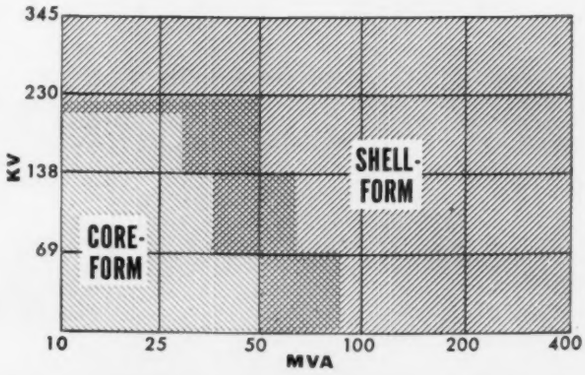
The pictured installation of main generating station transformers effectively illustrates Pennsylvania Transformer's versatility in the field of power transformer design. Both the core-form units, above, and the shell-form units are located at the same generating station, where they perform step-up service for two different generators.

The two core-form units are each rated at 56,000 kva when self-cooled, and at 70,000 kva when the forced-air cooling is in operation. Connected to a 110,000-kw generator, they step up a generated voltage of 15 kv to 132 kv.

The two shell form units are each rated at 105,000 kva, using forced-oil-to-air heat exchangers. Connected to a 156,000-kw generator, they step up a generated voltage of 19 kv to 132 kv.

Core-form or shell-form? Why not let the answer for your next transformer be based on Pennsylvania's proved principles of power transformer design?

TYPICAL APPLICATIONS OF CORE-FORM AND SHELL-FORM DESIGNS



PENNSYLVANIA POWER TRANSFORMERS

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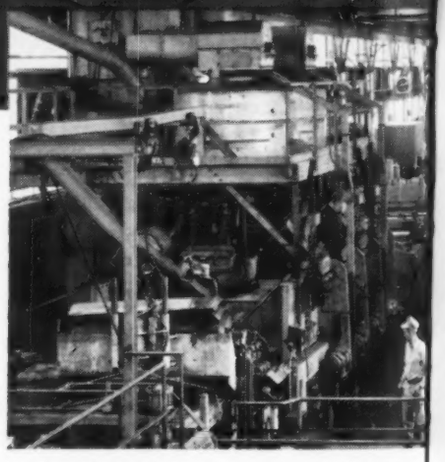
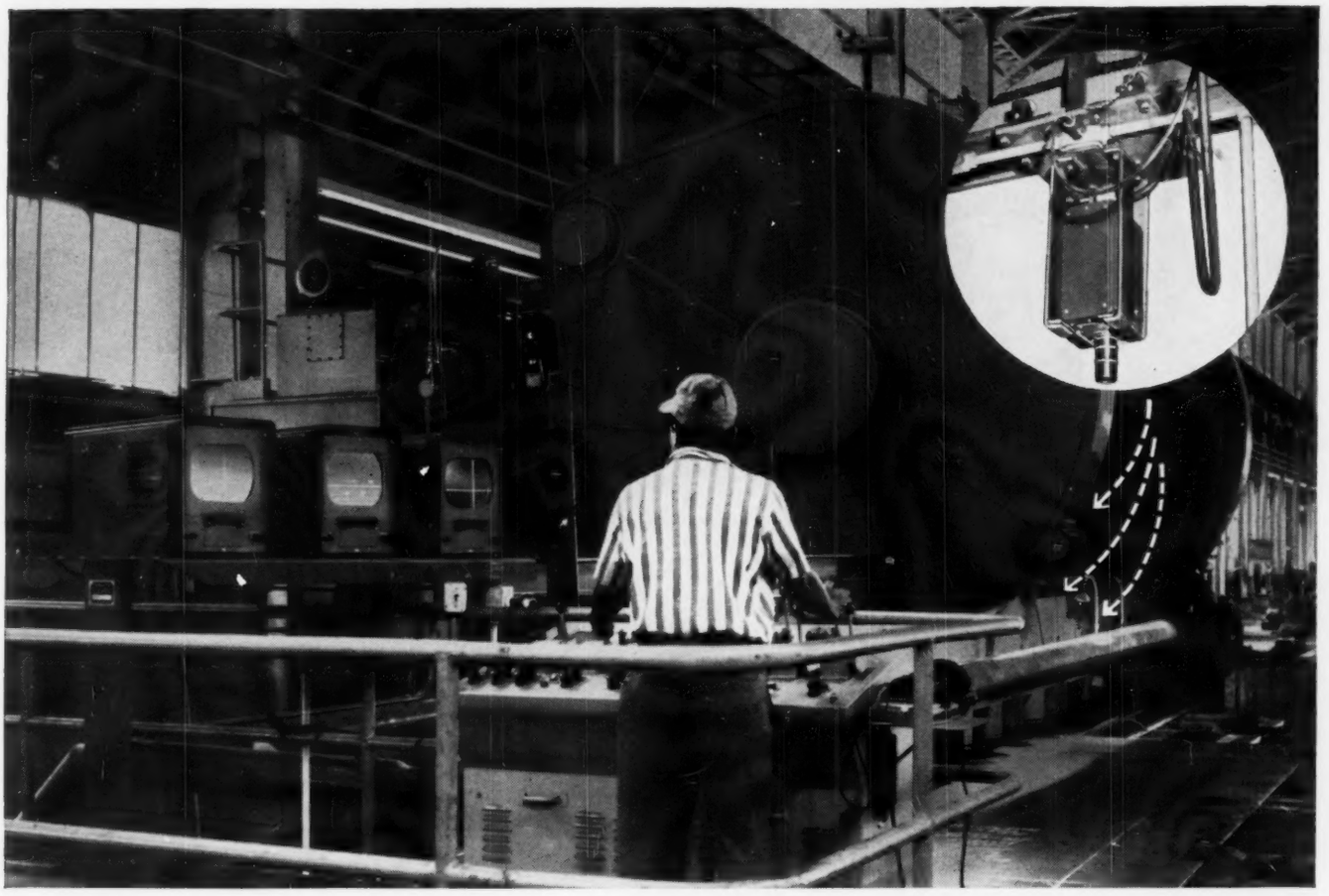


ROTOBLAST replaces pickling at Midland Steel.

Clean it fast with **Pangborn** *ROTOBLAST®*

PANGBORN CORPORATION, Hagerstown 4400, Maryland
Manufacturers of Blast Cleaning and Dust Control Equipment

ON A PLATE SHEAR AT LUKENS STEEL COMPANY, COATESVILLE, PA.



How to see where you can't be ...with RCA Industrial Television!

With RCA Industrial TV to guide him, one man at Lukens Steel Company controls this huge 800-ton plate shear although he cannot see the actual operation! Three RCA TV cameras installed above the blade are connected to three monitors located at the control position. Watching the monitors, the operator moves heavy plate into the shear, lines up the plate with a guide wire, and accurately trims it to size . . . all by remote control!

Wherever it is used, RCA Industrial TV has proved an outstanding factor in personnel safety, increased production, time and material savings. In power plants, factories, laboratories . . . wherever control of vital instruments, processes or materials is required . . . it can be counted on for reliable, accurate performance. RCA Industrial TV is designed and produced to exacting standards by the world leader in electronics.

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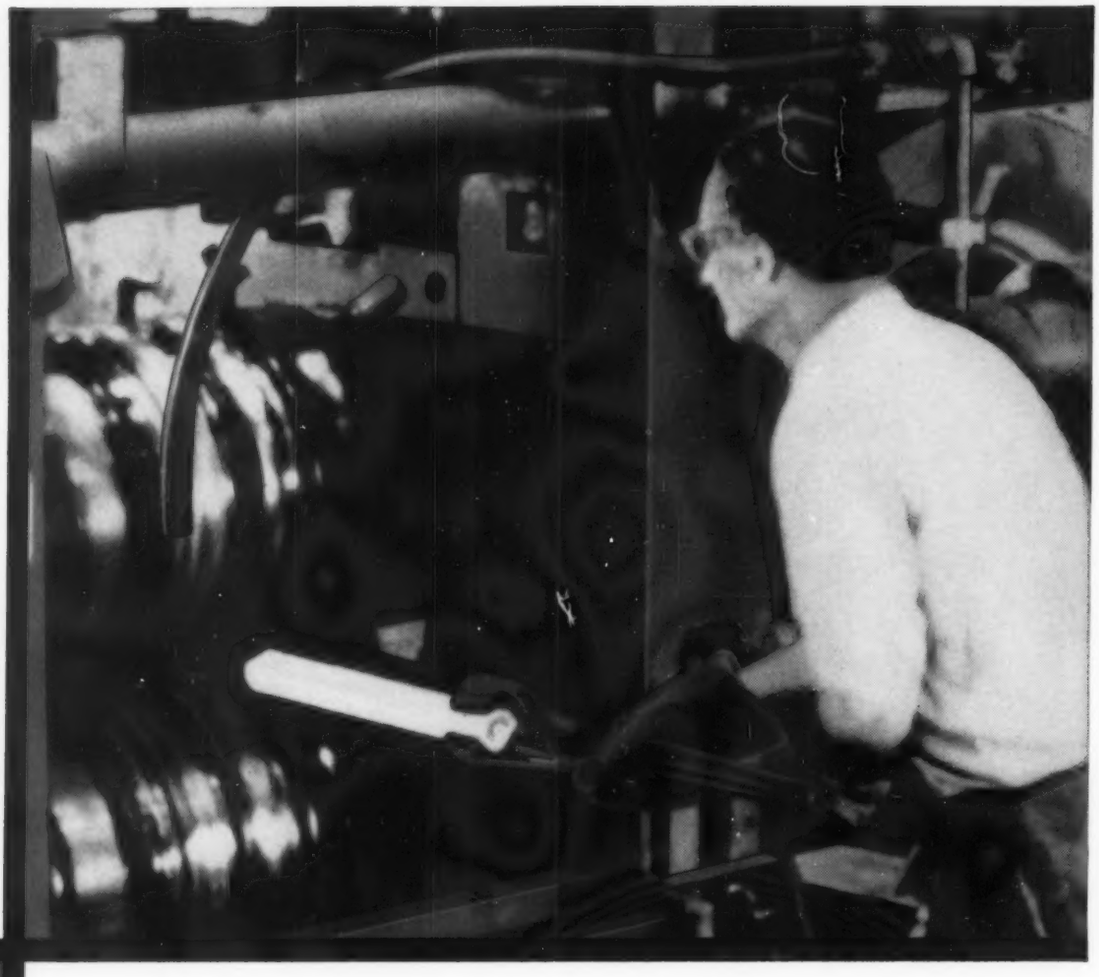

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BIRDSBORO *rolls and roll[illegible] mill machinery*

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Protection Against Prolonged Delays
on main drive electrical equipment

. . . . judicious selection of equipment can be an effective tool in minimizing number of spares which must be kept available for unscheduled breakdowns . . . . minor variations in design may be effective tools in accomplishing interchangeability.

by H. H. Angel
Electrical Engineer
Construction Engineering Dept.
Bethlehem Steel Co.
Bethlehem, Pa.

WITH the ever increasing demand for production, equipment installed 20 to 40 years ago is called upon to operate beyond its capacity. This imposes quite a maintenance problem and more frequent failures can be expected. However, failures do also occur on new or rewound equipment in operation a short time.

Scheduled preventive maintenance on equipment keeps delays to a minimum. It is not the intent of this paper to discuss maintenance, but rather to touch lightly on major spare parts and deal principally with complete spare units suitable for one or more plants of the Bethlehem Steel Co.

Most plants will provide initially a certain amount of spare parts for a large reversing motor, consisting principally of say a few spare armature coils to as much as a quarter of a set or more, two spare interpoles and main field coils, a few pole face bars and a few brushholders. Similar parts are kept for the generators. For a motor driving a motor-generator set, an eight of a set of stator coils or enough coils to cover one span, will generally be purchased. A few spare rotor coils are provided. In some cases, no spare rotor coils will be available.

Past experience is the guide in determining when full sets of spare coils should be kept on hand. If considerable trouble has been experienced with armature coils and stator coils in the first ten years' operation (or even the first few years) of a unit, future delay may be reduced by providing full sets of coils. After a fairly hard worked unit has been in operation for 20 years, even without trouble, a complete set of spare coils should be available. In some cases a half set or full set of field coils may be provided. With coils on hand, steps will be taken, under a preventive maintenance program, to plan for a rewind job in order to reduce the inconvenience and delay in a mill's operation.

Table I shows a list of major spare units for one or more plants, which have been provided in the past. This may help outline the equipment to be described.

In the early part of 1940, the mill side unit of a double armature motor, rated 2- x 1400-hp, 600-volt, 40/90-rpm, driving the Lehigh Division 35-in. blooming mill in the Bethlehem Plant, shifted about $\frac{5}{16}$ in. toward the mill, allowing the commutator risers to foul the brush holders, causing flashing and shutting down the mill. An investigation disclosed that the other armature unit had moved on the shaft approximately $\frac{1}{64}$ in. in the opposite direction, indicating both armatures were loose on the shaft. There were also signs that the laminations in the armature cores of the motor were becoming loose on the spiders as indicated by the appearance of rust.

At a conference between personnel of the Bethlehem plant and engineers of the motor manufacturer, it was decided to adjust the brushholders, permit mill operation under close observation until a steel spool, made in two halves, which would surround the shaft and become a spacer between the two armature spider hubs, could be installed. The spool would lock the two spiders to each other by providing twenty 2-in. diam bolts through the end flanges of the spool which were to be screwed into tapped holes to be provided in the armature spiders.

Since it would be difficult to determine how long the 25-year old motor would operate before corrective measures involving a complete restacking of the laminations and a complete rewinding estimated to require 20 to 24 days' shutdown, became necessary, it was decided to study the possibility of a spare. Three other mills, the Steelton Plant 44-in. blooming mill, the Sparrows Point 60-in. Universal plate mill and the Lackawanna plant 40-in. blooming mill use motors which are practically duplicates of each other, but have a higher rating than the one used in the Bethlehem Plant.

It was learned that if a complete double armature rotor with shaft suitable for the three other plants were purchased, certain modifications pertaining to shaft and bearing sizes could be made to the Bethlehem motor

TABLE I

Major Spare Units for Several Bethlehem Steel Co. Plants

Plant	Mill	Rating of unit	Spare	Where stored
Bethlehem Steelton Sparrows Point Lackawanna	35-in. blooming mill 44-in. blooming mill 60-in. Universal plate mill 40-in. blooming mill	Reversing motors 2- x 3000-hp, 600-v, 40/90-rpm 2- x 3500-hp, 700-v, 50/120-rpm 2- x 3500-hp, 700-v, 50/100-rpm 2- x 3500-hp, 700-v, 50/120-rpm	2- x 3500-hp, 700-v, 50/120-rpm armature	Steelton plant
Steelton Lackawanna Johnstown	44-in. blooming mill 40-in. blooming mill 34-in. billet mill	Motor on motor-generator set 4800-hp, 3-25-cycle, 6600-v, 375-rpm 3750-hp, 3-25-cycle, 6600-v, 375-rpm 4000-hp, 3-25-cycle, 6600-v, 375-rpm	4000-hp, 3-phase, 25-cycle, 6600-v, 375-rpm motor	Steelton plant
Steelton Johnstown	44-in. blooming mill 46-in. blooming mill	Generators 2- x 3500-kw, 800-v, 375-rpm 2- x 3500-kw, 800-v, 375-rpm	One 3500-kw, 800-v, 375-rpm armature	Johnstown plant
Sparrows Point	40-in. blooming mill 54-in. blooming mill 40-in. Universal slabbing mill	Reversing motors 2- x 3500-hp, 650-v, 50/100-rpm, each mill	2- x 3500-hp, 650-v, 40/100-rpm armature	Sparrows Point
Sparrows Point	40-in. blooming mill 54-in. blooming mill	Generators 2- x 3000-kw, 650-v, each mill	One 3000-kw, 650-v armature	Sparrows Point
Lackawanna Johnstown	28-in. structural mill 34-in. billet mill	Generators 2- x 2100-kw, 600-v 2- x 2100-kw, 600-v	2- x 2100-kw, 600-v armature	Johnstown
Lackawanna	21-in. mill 54-in. cold strip mill 79-in. hot strip mill	Five motor-generator sets	6000-kw rectifier	Lackawanna
Johnstown	46-in. blooming mill	2- x 4000-hp, 800-v, 40/100-rpm motors	One 4000-hp, 800-v, 40/100-rpm armature	Johnstown

in order to use this spare. The principal changes consisted of:

1. Provide one special pedestal and bearing, 28 in. diam x 62 in. long for end of motor away from the mill.
2. Modify mill and bearing housing to take bearing 28 in. diam x 62 in. long instead of present 25 in. diam x 62 in. long.
3. Modify pinion end of mill drive shaft to permit of 3 in. extension of the motor shaft.
4. Modify motor half of present coupling for 28-in. diam shaft instead of 25-in. diam shaft.

It was decided in December, 1940, after inspections which showed the Bethlehem plant armature to be in worse condition than at the time of the trouble, to buy a spare armature and mount in a special car to be supplied by the Bethlehem Steel Co. The spare would then be installed at an opportune time and the one taken out would be rebuilt to make it a standard spare for four plants.

Figures 1 and 2 show two views of the present spare on B.S. Co. Car 10001 which is kept at the Steelton plant.

Weight of car, including 5900-lb cover	143,400 lb
Weight of armature, no coupling	188,900 lb
Total	332,300 lb

The clearance authority between the railroads and the various plants has been established. This car is pulled by a locomotive with an idler car between same, in order to distribute bridge loading. Transportation is during daylight hours only and at a maximum speed of 25 miles per hr.

The spare was installed in the Bethlehem plant motor in the last week of December, 1941, and since that time the repaired or rewound armature, which becomes a "Corporation Spare," has been used three times. A brief description of the changes follows:

The Bethlehem plant motor is located under crane runways between two adjacent bays and it was necessary to design and construct a temporary crane run and two trolleys to move the old armature out and the new one into position. Considerable work was necessary because of pedestal changes. The job started at 7:40 am 12/23/41 and the mill was placed in operation seven days, 18½ hr later.

The original 5800-hp, 600-volt armature in the Steelton plant, 44-in. blooming mill started operations in January, 1921, and in over 29 years of operation, broken risers and commutator cross connections occurred at times, but nothing very serious until the latter part of March, 1950. At that time a broken mill spindle pushed the armature hard against the thrust bearing, and the mill gear box towards the mill and damages ensued. The thrust bearing housing became cracked in several places. This accident really started trouble with the armature risers, cross connections and commutation, making it necessary to replace some risers, resolder some cross connections and grind the mill end commutator. These were temporary expedients to keep the mill operating, but with some delay.

It was decided to install the spare which is kept in

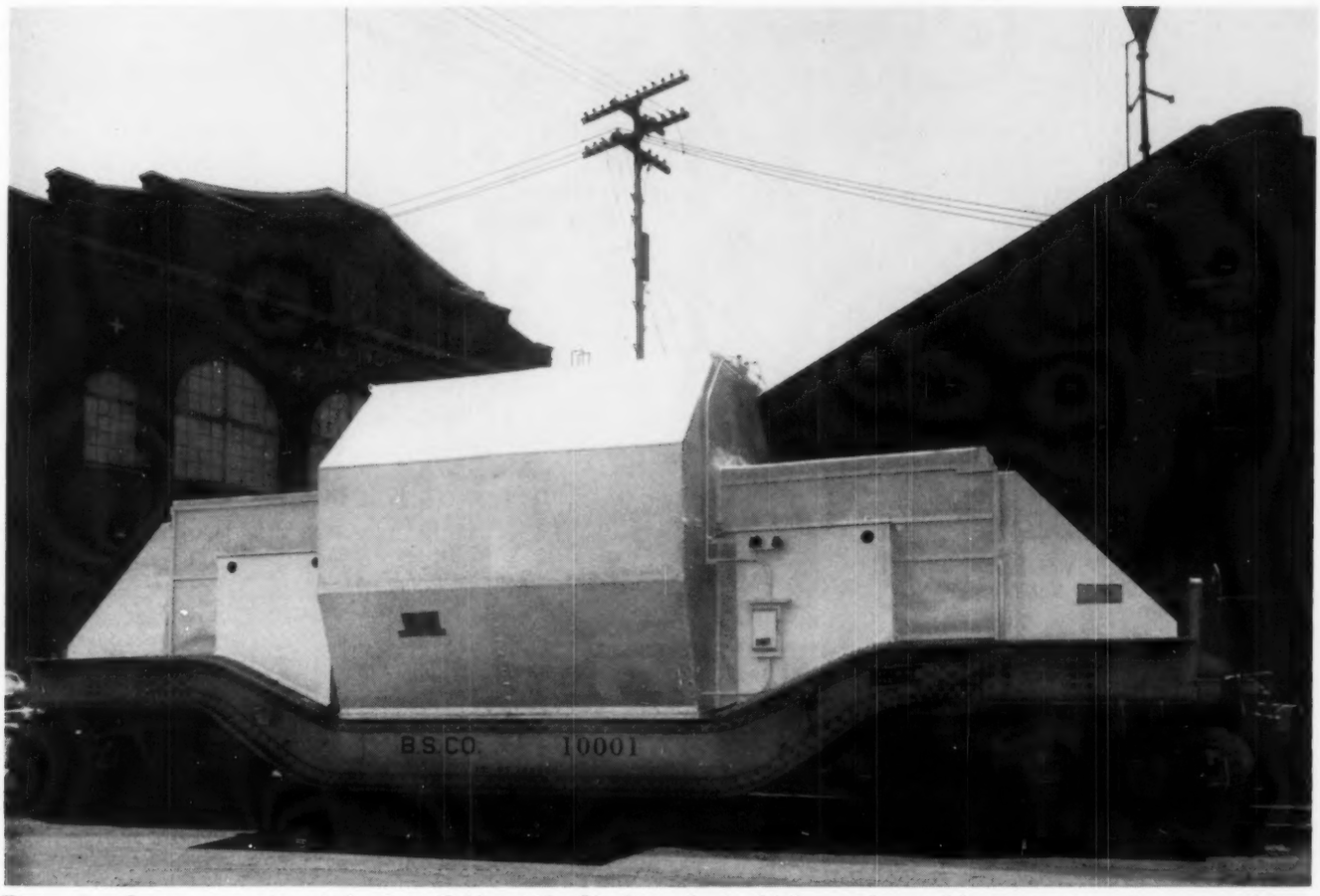


Figure 1 — A spare armature is kept available at the Steelton plant which may be used in emergency at any one of four plants.

Steelton. The motor room crane was used in removing the old armature and transporting the spare from the car into the motor. Total elapsed downtime was 62 hr and 40 min which was longer than anticipated due to time required for motor shunt field repairs and unforeseen time spent on bearing piping, since spare bearing shells from other plants were installed. The armature was sent to the manufacturer where it was completely rewound and new commutators furnished. Figure 3 shows an end view of the motor.

The 7000-hp motor in the 40-in. blooming mill in the Lackawanna plant, had been running since May, 1924, and no serious trouble developed, other than replacing several armature coils in December, 1949, until the commutator risers and connections started to break in August, 1950. The spare armature in car was sent to the Lackawanna plant and preparations were made to change it at the most opportune time, which was November 3, 1950.

Since it was not possible to get the armature in the mill and pick it up with the motor room crane, it was decided to have an outside rigging contractor use trailers. It required two days to build a ramp 30 ft in width and 75 ft in length leading into the motor room. The armature was removed from the motor and placed on the trailer inside the motor room. It was then pulled outside, and the other trailer with spare armature was pushed into the motor room. The mill was shut down $77\frac{3}{4}$ hr.

The old armature was rewound, new commutators furnished and then sent to the Steelton plant for storage.

On January 17, 1956, the equalizer bar on the coupling for the above mentioned mill broke, causing the drive end bearing pedestal and armature to move $\frac{1}{8}$ to $\frac{3}{16}$ in., and bending the armature shaft to a total runout of nearly $\frac{1}{16}$ in. Emergency repairs were made and the mill resumed operations after $19\frac{1}{2}$ hr downtime.

The motor seemed to run fairly well, and further checks were made to shaft eccentricity during the next repair turn. It was decided to arrange to change the armature at the most opportune time as continued

Figure 2 — Total weight of car with armature is over 330,000 lb.

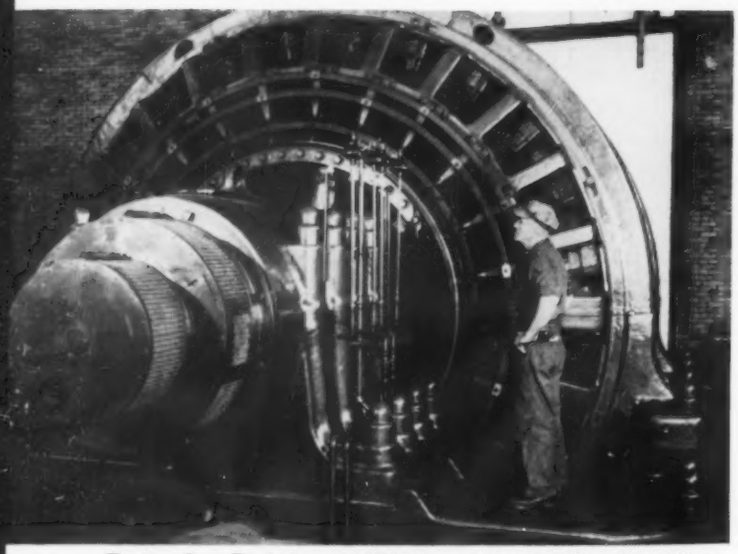


Figure 3 — End view of 5800-hp motor for Steelton 44-in. blooming mill.

operations might cause excessive wear to the spherical seats of pedestals and bearings. It required 5 days to move the armature car from Steelton to Lackawanna, a distance of about 300 miles. The mill was shut down at 7:00 am February 20, 1956, about 14 days after receipt of armature, and resumed operations after a downtime of 57¾ hr., which was 20 hr less than the change made four years previously.

Figures 4, 5 and 6 show some views of the job which were taken February 21, 1956.

The armature was returned to the manufacturer where the shaft was straightened and trued up without removing same from the spider hubs.

The above descriptions indicate that the armature has been used successfully in four instances, resulting in the minimum delay possible. We have been cognizant of the fact that a spare must be kept in such condition that it can be used without any drying out, extensive shaft cleaning, etc., and the car with the spare must be acceptable to the railroads at all times. We have not always been able to reach this goal. The car has always been kept outdoors, simply for lack of indoor space. Heaters are used to keep the armature above the dew point. Megger readings and the condition of the armature, except shaft, have always been satisfactory. In spite of the care taken in protecting the shaft, some rust spots have developed. Keeping the journals of the car free from pin points of rust has always been difficult, while the car is kept outdoors. The weight on the journals is about the maximum for the size used, and since slight overheating did occur on one babbitted brass bearing in transit, the railroads rightfully insist on keeping the journals free from pin points of rust. For outside storage, the car should be moved every two or three weeks. For a long period of time, the car was raised off the journals, and the latter were coated with a rust preventive-compound, selected from past tests made on crane parts stored outdoors at several plants. In spite of frequent inspections and re-treatments, we still have rust. By the time this paper is presented, it is hoped the car will be stored in an extension made to the Steelton plant electrical repair shop.

So far, we have shown one spare armature for the reversing motors. We do have a spare 4000-hp, 3-phase, 25-cycle, 6600-volt, 375-rpm wound-rotor motor kept in the Steelton plant which has been used in the past as a replacement for flywheel motors in the Steelton plant 44-in. blooming mill, 4800-hp, the Lackawanna plant 40-in. blooming mill, 3750-hp, and the Johnstown Plant 34-in. billet mill, 4000-hp. The individual coils in these motors are not all the same. In one mill, a special pedestal is sent along with the spare motor.

The 46-in. blooming-slabbing mill in our Johnstown plant has a twin drive using two 4000-hp, 800-volt, 40/100-rpm motors. The generators are rated 3500 kw, 800 volt. Figure 7 shows the motors and the flywheel set and Figure 8 the flywheel set alone. This equipment was placed in operation in November, 1951. Since all plant products pass through this mill, a spare armature was purchased. It is kept in the motor room. The shaft is protected, but must be raised occasionally for inspection. No spare generator armature was provided originally.

In 1952 it was decided to increase the lift of the Steelton plant 44-in. blooming mill in order to roll wider

Figure 4 — Armature was changed on 40-in. blooming mill at Lackawanna in February and March, 1956.

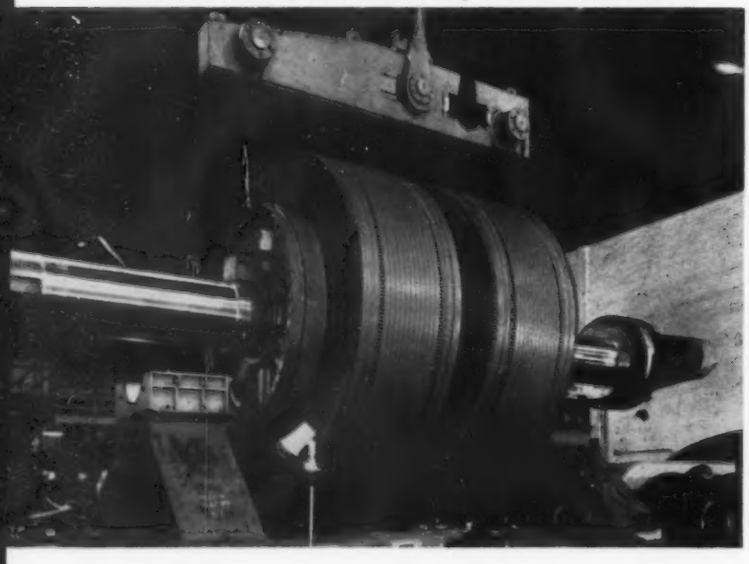
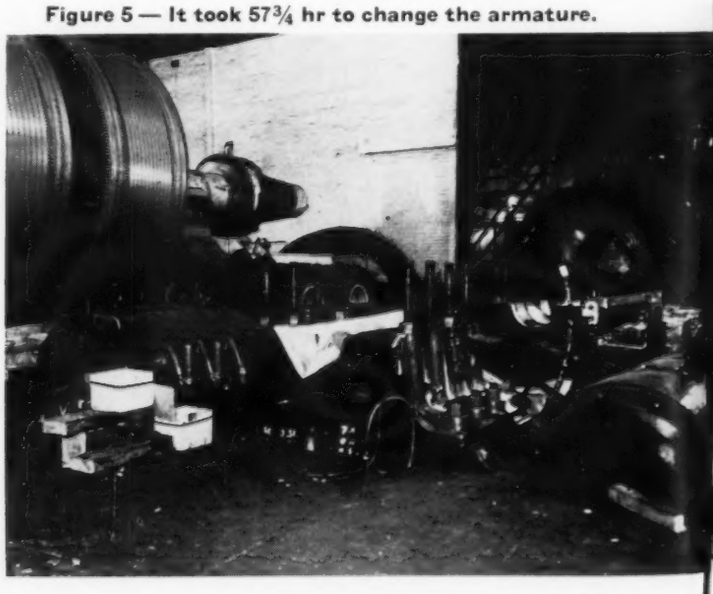


Figure 5 — It took 57¾ hr to change the armature.



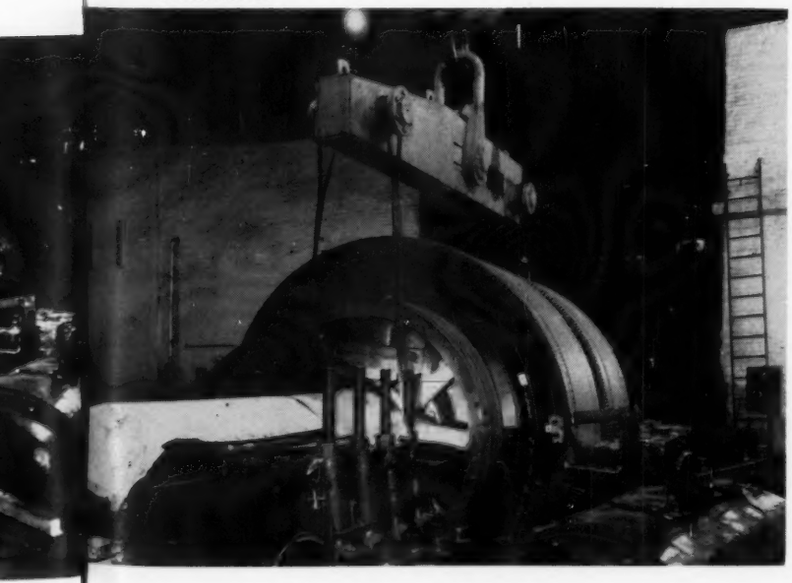
slabs. This required a new mill housing, new main table, etc., and additional horsepower for the main drive. The mill motor was rated 5800-hp, 40/120-rpm at 600 volts. Since the generator voltage could not be raised, and the generators were overloaded and not in good condition, it was decided to buy new 700-volt generators in order to run the motor output to 7000 hp. The physical arrangement required generators narrow in length, and it was determined that duplicates of the Johnstown generators could be used satisfactorily. These were purchased and installed and have been operating since June, 1954. They are operating at 700 volt and the rating is 3060 kw. Figure 9 shows these generators.

Since the Steelton and Johnstown plants have only one blooming mill each, a prolonged delay would really "shut down the plant." Last year a spare generator armature was ordered and it will serve as a spare for four generators. Figures 10 and 11 show the armature and the cradle. It will be kept at the Johnstown plant.

The cradle for the armature was designed on the basis of extreme minimum weight and over-all dimensions in order to permit hauling by truck, with permission from the Pennsylvania State Highway Department as the cradle and armature exceed the nominal maximums in weight and width. It may not be moved by night and on holidays. However, there may be time saved by truck transportation. Figure 12 shows the spreader and method of handling the armature. It is estimated that 32 hr will be required to install a spare armature. Estimated rewinding time for an armature is 12 days.

The double armature motors rated 7000-hp, 650-volt, 50/100-rpm for the 40-in blooming mill, 54-in. blooming mill and 40-in. Universal slabbing mill at Sparrows Point are duplicates. Some years ago a spare single armature without shaft was purchased. It was never necessary to use it, and as the plant tonnage increased and one motor had been in service since 1919, it was decided to buy a second spare with a shaft and assemble as a complete unit, similar to that described for four plants, in order to protect against a prolonged delay.

Figure 6 — Equalizer beam was used in lowering the armature.



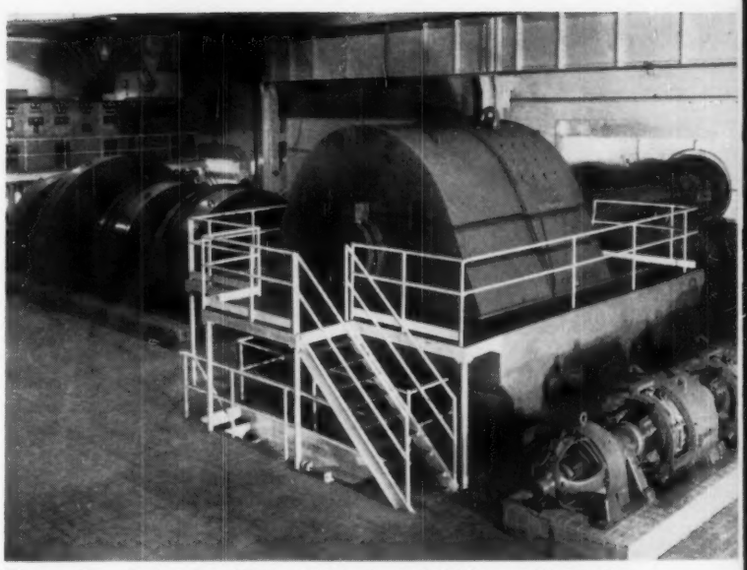


Figure 7 — Drive for 46-in. blooming-slabbing mill at the Johnstown plant has two 4000-hp, 800-volt, 40/100-rpm motors.

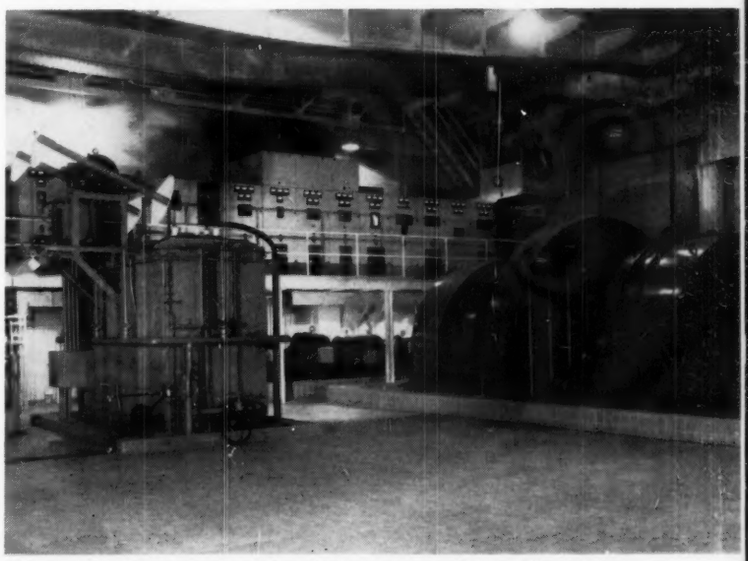
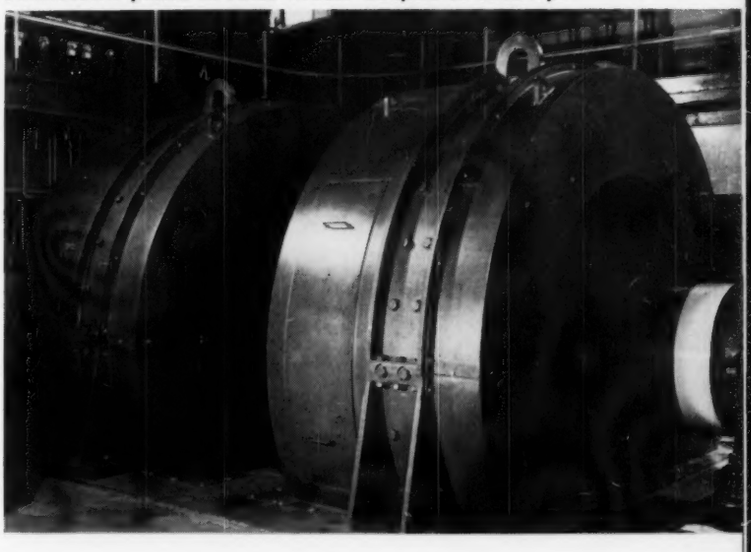


Figure 8 — Flywheel set for Johnstown's 46-in. blooming-slabbing mill.

Figure 9 — New 700-volt generators were installed at the Johnstown plant to raise motor output to 7000 hp.



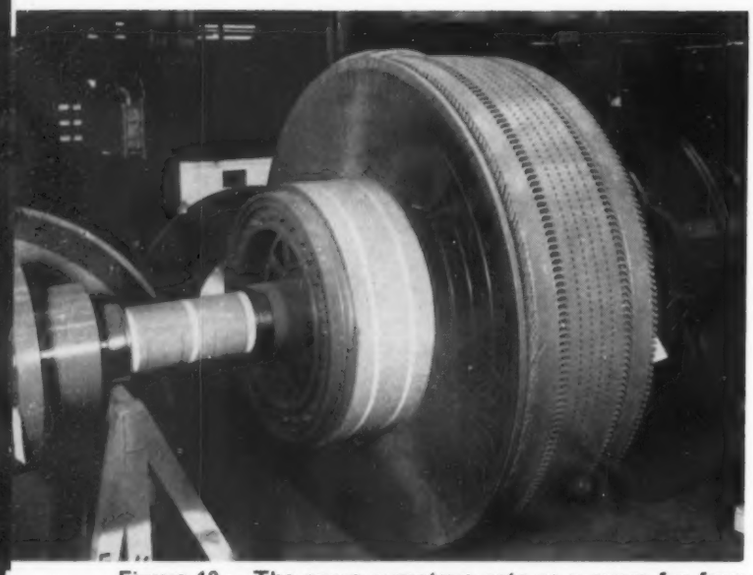


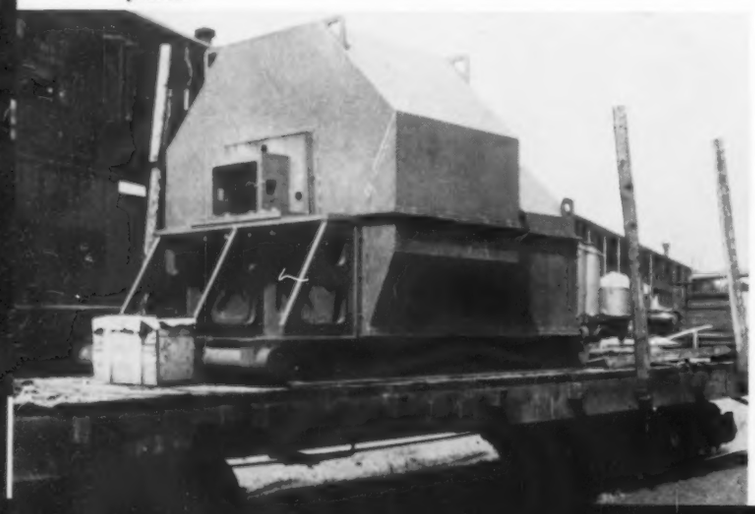
Figure 10 — The spare armature acts as a spare for four generators.

Figure 13 shows a view of the horizontal roll reversing motor, the vertical roll motor, and the car with armature and cover, in the 40-in. Universal slabbing mill motor room. Figure 14 shows a closeup view of the car. This car is intended to transport the armature to the two blooming mills, which have tracks into the motor rooms and the mills. Railroad clearance to the manufacturer's shop has been obtained. The armature shaft is protected against corrosion, but must be inspected yearly or bi-yearly. The journals of the car are also protected.

Each of the 40- and 54-in. blooming mills at Sparrows Point has 2- x 3500-kw, 650-volt generators on the flywheel sets. These generators have been in hard use since 1919 and 1926, respectively, and are duplicates mechanically and electrically. A spare for the four units, complete with shaft and coupling, has been available for a number of years and has been applied twice. The armatures of the 40-in. blooming mill were replaced in May, 1952, and December, 1953, after many years of good service. It required approximately 20 to 24 hr for each change. Estimated time to rewind an armature on emergency basis is about seven days.

In the Lackawanna plant, between the 44-in. blooming mill, 54-in. blooming mill, and the 48-in. rougher and 48-in. finisher mills, there are a total of ten 3000-kw 750-volt generators. All are electrical duplicates, seven

Figure 11 — The spare armature is kept at the Johnstown plant.



have the same shafts and couplings, while the remaining three have two different kinds of shafts. No spare has been available, but the generators on the generally more important blooming mill drives have been replaced by using those from the 48-in. rougher and finisher mills. However, at a time like the present, when structural steel is in heavy demand, all of the units are of comparable importance. On a planned change, about 24 hr is required. Estimated rewind time about 8 to 10 days. If a group of armature coils burn out, the so-called "planned change" could not be made and hence more than 24 hr would be required. However, there have been several instances in the past where the bad condition of insulation, commutator arcing from poor soldering, bad equalizers, etc., has necessitated planned changes.

A good many years ago complete electrical equipment was transferred from the Lackawanna plant to the Johnstown plant to operate a 40-in. blooming mill now used on 34-in. billet mill. This equipment was a duplicate of that used in the 28-in. structural mill in the Lackawanna plant. A spare generator unit, consisting of two 2100-kw, 600-volt generators on one shaft was sent along with it. This is available for both plants.

We do not have complete spare unit protection for all blooming mills. To obtain this, in some cases it would be necessary to order a spare armature suitable for only one motor, and several units of two spare generators on one shaft, suitable for only individual motor-generator sets. Several years ago, the subject of having a spare motor generator set of the flywheel or synchronous motor type to be mounted on a special car and suitable for use in several plants, was seriously discussed. It was found, however, that the sizes and weights involved would not make such a project very practical. This idea might become closer to realization in the future when mercury arc rectifiers are used in the United States for such service.

Figure 15 shows some duplicate equipment used in the 54-in. cold strip mill, 79-in. hot strip mill and 21-in. continuous mill in the Lackawanna plant. This equipment is from 23 to 27 years of age and has never been rewound. Full sets of armature and stator coils are available, as well as a few spare shunt field coils. It was felt that since the insulation may be approaching the end of its useful life, in which failures might result in a prolonged delay, the advisability of obtaining complete spare units should be called to the attention of management.

You will notice that three motor-generator sets for the cold strip and hot strip mill are duplicates, as shown in references 3 and 4, while the one motor-generator set in the hot strip mill and the one in the 21-in. continuous mill are duplicates, as shown by references 1 and 2.

In order to get good protection, it would be necessary to buy one each of 2000-kw and 3000-kw generators and one each of 5600-hp and 8500-hp motors. One must find space for this equipment. There is a reluctance to buy large 25-cycle motors. Of course, one each of 60-cycle motors could be purchased and placed in operation as 60 cycles is available in the strip mill area. The Lackawanna plant had proposed a 6000-kw rectifier to be placed on the 600-volt, hot strip mill bus in emergency, thus releasing one of the larger motor-generator sets if one

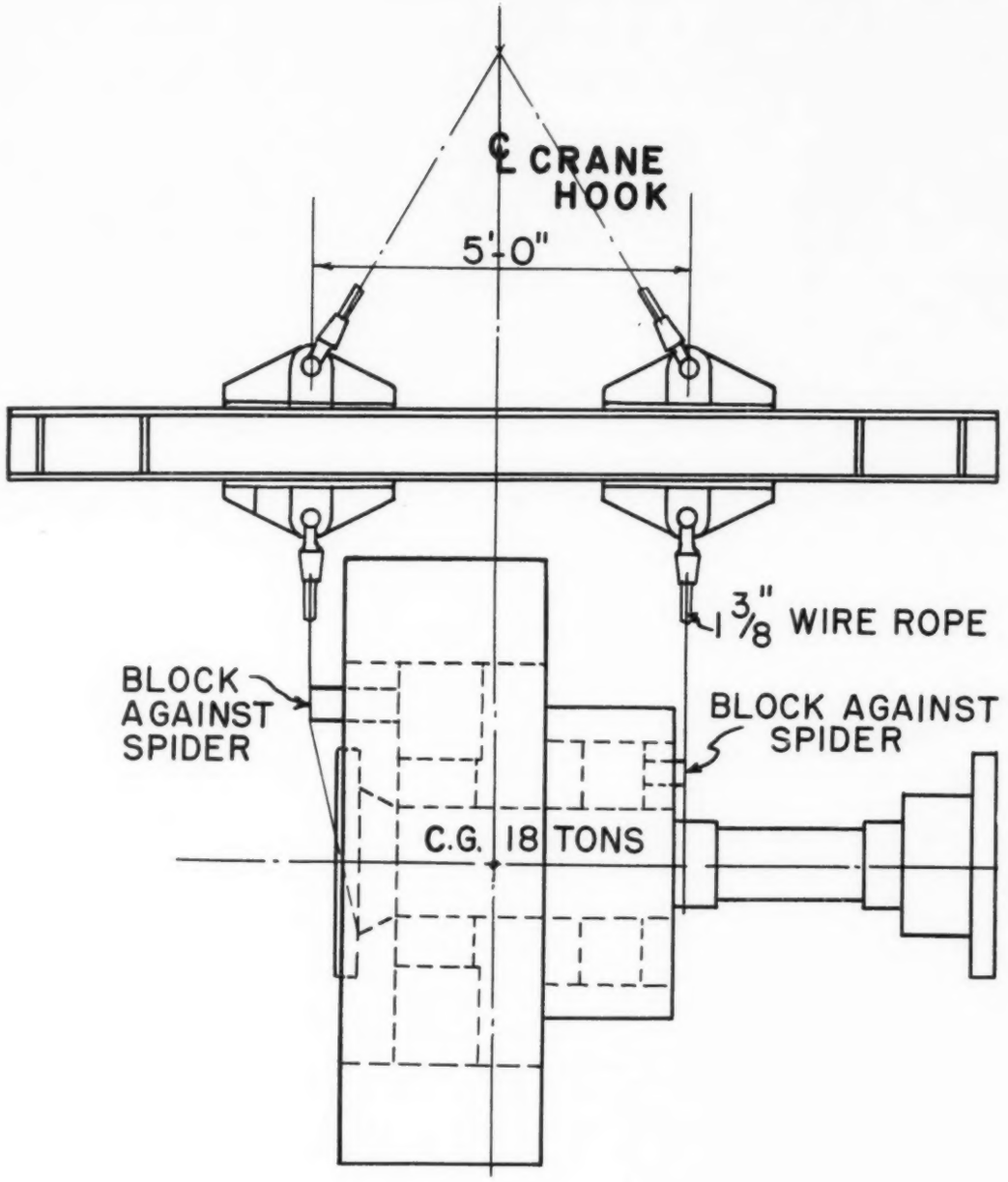


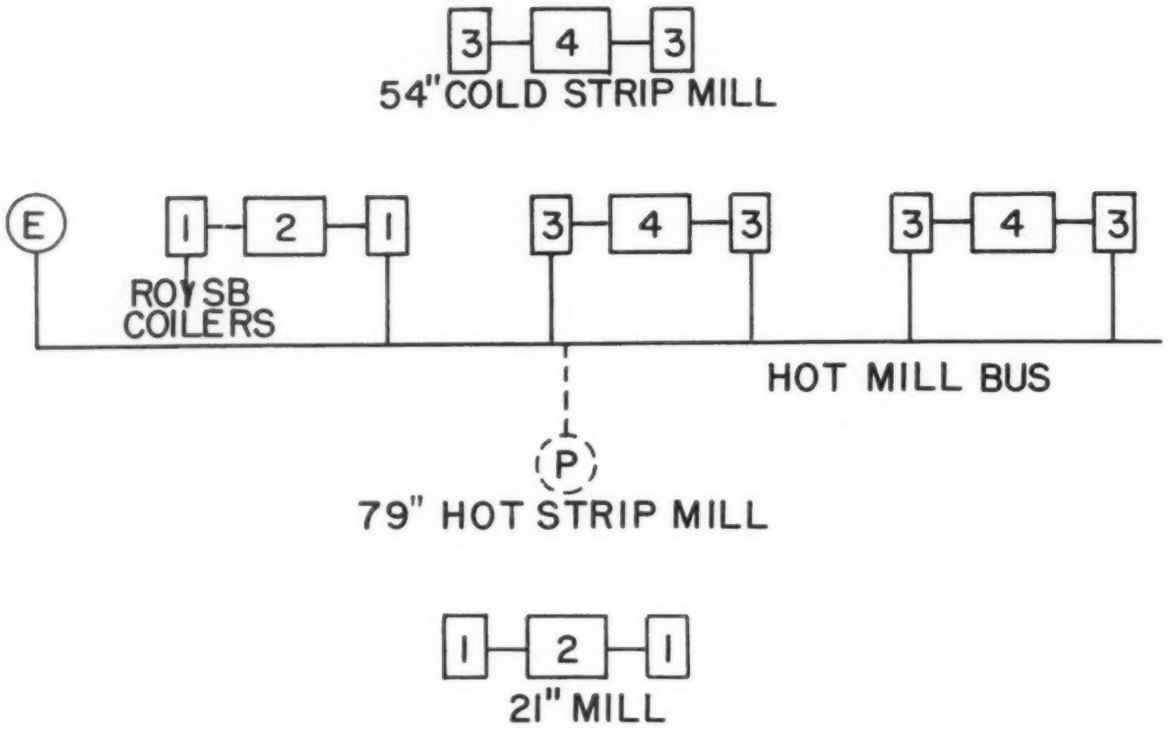
Figure 12 — Arrangement for lifting rotor for 3500-kw, 800-volt generator for Johnstown's 46-in. blooming-slabbing mill.

failed on that bus, or using it if the cold strip mill set failed. If the small set in the hot strip mill failed, the rectifier would release a large set which could handle the load now carried by the one in trouble. If the 21-in. mill set failed, the duplicate set in the hot strip mill would be shut down and the motor or one of the generators would be applied to the 21-in. mill.

Actually, we would like to reduce the 25-cycle load and also the temperature in the hot strip mill motor room. This may be done by running the 6000-kw, 60-cycle rectifier all the time and shutting down a large motor-generator set. If the future load increases, and we believe it will, then a set ordinarily kept shut down as a spare could be started and one of the 3000-kw gen-

Figure 13 — Armature sits on the car in motor room.

Figure 14 — Closeup view of car in Figure 13.



REF.	EQUIPMENT	YEAR INSTALLED
1	2000 KW, 600 V. DC 500 RPM, GENERATOR	1930
2	5600 HP 6600 V. 25 CYCLE 500 RPM, SYNC. MOTOR	1930
3	3000 KW, 600 V. DC 375 RPM, GENERATOR	1935
4	8500 HP 6600 V. 25 CYCLE 500 RPM, SYNC. MOTOR	1935
E	4000 KW-13.8 KV 60 CYC.-600 V. DC, EXIST. RECTIFIER	1950
P	PROPOSED-6000 KW, 13.8 KV 60 CYC. 600 V. DC RECTIFIER	

Figure 15 — Schematic sketch shows plan for installing 6000-kw rectifier in 79-in. hot strip mill motor room.

erators could increase the capacity of the bus, making it 21,000 kw when necessary. The rectifier is now on order.

There are actually other drives of lower capacity in various plants where complete spare armatures are available, such as for d-c motors on cold strip mills, etc. These have been applied a number of times. However, only the most important ones, especially where one spare will serve one or more plants, have been discussed.

In conclusion, we believe that the equipment provided has and will continue to serve the purpose for which it was intended. We must realize of course that proper storage facilities, which are not always easy to obtain, should be available for spare coils and spare units. Proper protection against moisture, drying out of insulation and physical damage is a necessity.

The maintenance department may not always have on hand all the spares they consider necessary. However, they must be on the alert, as risks become greater, to call management's attention to prolonged delays and loss of product which might result from failures due to burned out windings, laminations, shaft damage or any other causes.

Discussion

PRESENTED BY

R. M. DUNAISKI, Large Motor and Generator Dept., General Electric Co., Schenectady, N. Y.

H. H. ANGEL, Electrical Engineer, Construction Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

E. H. MYERS, Manager, D.C. Motor and Generator Engineering, Westinghouse Electric Corp., East Pittsburgh, Pa.

I. N. TULL, Superintendent, Electrical Dept., Republic Steel Corp., Cleveland District, Cleveland, Ohio

V. E. HOLTSLANDER, Assistant Superintendent Electrical Dept., Inland Steel Co., Indiana Harbor Works, East Chicago, Ind.

R. M. Dunaiski: In his usual comprehensive manner, Mr. Angel disclosed how good planning can reduce unscheduled downtime on numerous hot metal rolling

mills at Bethlehm Steel Co. Mobile spare armatures extend the coverage of some of the principal spare part investments.

Mr. Angel's talk has sponsored three questions, which are:

1. On what basis does a steel company decide the extent of the spare or replacement part investment to be made? For instance, when does one decide to invest in a complete spare armature in preference to a ¼ set of coils and winding supplies?

2. Have you considered joint ownership of major spares with other steel companies?

3. What features or accessories of the electrical equipment proved helpful in reducing downtime or time required for maintenance? What improvements or changes would you recommend?

Elaborating, briefly, on these three questions, it appears that past experience is the guide in determining the extent of spare part protection to be followed. Often, steel companies will consult the electrical manufacturer for their recommendation. However, is it not possible to answer the question of *what* and *how much* to invest in spare parts on a dollar and cents basis, tempered with judgment rather than on the basis of trying to out-guess the performance of a machine? It appears that we engineers can benefit by an accountant's approach to the problem. On one side of the ledger the accountants can determine the hourly worth of a particular mill, recognizing that the cost of downtime will have some rather wide fluctuations of hourly value when one considers the mill as an integrated part in the process of making steel. Furthermore, it should be recognized that the hourly value of a mill will vary day by day as market conditions, mill expansion, production rates, etc., vary. On the other side of the ledger, we can assist the accountants in arriving at the costs of some of the more frequent causes of unscheduled downtime by referring to the records on past failures. With these numbers at one's fingertips then, one can determine whether the probability of a failure, such as a rotor coil, would warrant the stocking of coils or a complete armature. In other words, would an A + B approach be of any use on the selection of spares?

The second question concerns the feasibility of joint ownership of principal spares. Although many customers have electrical equipments which are duplicate in rating, and often mechanically duplicate as well, there is little joint ownership of principal spares. In one instance, our company furnished a spare armature for a 6000-hp, 40/100-rpm twin drive blooming mill which was suitable for four different mills in three different customer plants by modifying the drive couplings. This type of spare coverage is a rarity rather than the common practice among the steel companies. It seems that there may be many instances where a customer cannot justify a complete spare for a large main drive; however, when more than one mill is involved, the expenditure may be more than justified. If this type of thinking were exercised in the early stages of planning and design, it would undoubtedly influence many of the minor variations which could be made so as to permit readily replacing of principal parts among the various steel companies.

The third question concerns the part the electrical manufacturer can play in assisting the steel company in their efforts to reduce downtime. The economic benefits of preventive maintenance is becoming better understood by operating people. We have furnished cradles and enclosures for spare armatures of the type mentioned when the customer's needs are made known to us. We believe it is our duty to design "ease of maintenance" into a machine and we feel that generous strides have been made toward this end in recent years. Will Mr. Angel describe any features such as enclosures, bearing arrangements, accessibility, etc., which, if changed or improved, would benefit his operations.

H. H. Angel: It would appear that buying a large horsepower spare armature for one drive only, when it is new, would be very expensive, unless some very special economic considerations were involved. As the equipment becomes older, certain past troubles or the appearance of the insulation might lead one to believe that a future failure is imminent. The electrical manufacturer would generally be consulted, especially about the time required to make repairs. The least you can do would be to order a set of spare coils.

If the mill were to be down say two to three weeks, serious consideration should be given for a spare, especially if it were possible to get one to perform better than the unit in operation. Management's decision might be based on the cost of the spare, the downtime, and how much inconvenience would be caused the customers using the products.

We have a serious situation now in our Lackawanna plant. There are no spares for two dissimilar 7000-hp blooming mill drives, which are working hard and should be rewound. We have had troubles in the past, especially in the last few months, due to age and the overload resulting from a tremendous increase in output since the drives were installed. The little leeway available when the mills were installed about 25 years ago has disappeared. It was never deemed advisable to carry spares for only one motor of a kind. However, the subject of joint ownership might have been considered.

I might say that when severe overloading occurs on a main drive, the mill people know it just as well as the electrical people due to the number of times a mill is stalled from the operation of current limit control or the circuit breaker opening. The mill people are asked to reduce the draft on passes to partially alleviate this condition. Sometimes extra indicating and even graphic ammeters are installed in the roller's pulpit.

Much has been done in recent years to improve accessibility, enclosures and ease in installing spares. Some solid and heavy enclosures over end bells, commutators and field frames have been replaced by lighter weight units having access inspection openings and doors, and the latter type are practically standard on installations in recent years. Many years ago two duplicate generators in a mill were furnished with one shaft, and in some cases, two generators duplicating the above in ratings were furnished on a different shaft, making it necessary to purchase, if considered necessary, two generators on one shaft for each of the two motor-generator sets. This practice has been discontinued in favor of duplicate generators on single shafts with coupling connections.

E. H. Myers: We would like to not only compliment Mr. Angel highly on his paper but also to tender him our heartfelt thanks for so ably championing our

favorite causes—preventive maintenance and realistic preparedness for possible machine failures. The Bethlehem Steel Co. is to be congratulated on its progressive attitudes.

As machine manufacturers we must admit that equipment has not always been designed to make such preparedness as easy as possible. In the past, machines with duplicate ratings purchased from one manufacturer were not necessarily mechanical or electrical duplicates, especially if they were ordered at considerably different times. This makes the use of a single spare for many of these old machines quite difficult.

Our present practice is to provide the maximum interchangeability of parts on machines which have duplicate ratings as long as operation is not adversely affected. For instance, good mechanical design would indicate the use of successively smaller and smaller bearings on several generators with the same ratings the farther the particular generator considered was from the driving motor of the motor-generator set. This is because the shaft of the generator nearest the motor must transmit not only its own torque but also the total of all the generators beyond it. On modern machines we would provide all the generators with duplicate bearings and shafts to suit the largest required.

A similar practice is followed on drive motors where two or three armatures are connected in tandem to drive a single roll. In this case, the rotors are made exactly interchangeable by providing a flanged stub shaft for the large bearing next to the mill and providing machine armatures with single front bearings and flanges at both ends of the rotor shafts. Thus all the machine bearings are duplicates as are the rotors and stators.

It is not uncommon to provide stators with extra fields which will not be used on the particular machine just to provide interchangeability with other machines used by the customer for other purposes.

Also, rather costly (to the manufacturer) is our practice of providing interchangeability of huge reversing mill motor bearings by supplying identical front and rear bearings. Of course this means the forward bearing is far too large for its requirements, but this is done whenever space limitations will permit the purchase of only one spare bearing.

Customers are often surprised that we are able to furnish spare machines and parts that can be used on motors and generators built at considerably different times and which are obviously of quite different mechanical construction.

A rather spectacular example of this occurred recently when we furnished a complete spare generator suitable to replace any one of 26 units which were built for different plants of the customer over a period from 1924 to 1942. These 26 units definitely were not duplicates. In the group there were:

Two ratings 3500-kw, 700-v, 370-rpm.
3000-kw, 700-v, 370-rpm.
Two armature diameters 90 and 100 in.
Two armature core lengths 12½ and 13½ in.
Three different frame diameters.
Three different foot heights and foot arrangements.
Three different bearing journal sizes.
Five variations of rear end couplings and shaft extensions.
Six variations of front end shaft extensions.
Both fabricated and cast constructions.
Six units had involute necks and the other 19 used standard armature cross connections.

The customer needed a spare which would suit all of these machines so that he could quickly remove one at a time by replacing it with the spare, perform the necessary preventive maintenance, and then return the old unit to production with minimum outage time. This was accomplished by providing a modern 3500-kw generator with a special rotor suitable for eleven different stub shafts to suit the various mechanical arrangements on the customer's many motor-generator sets.

Two rocker rings suitable for quick assembly were provided complete with brushholder brackets, brushholders, brushes (all sanded in) and brushholder cross connections to suit the two possible rotations.

The various frame and foot arrangements were accommodated by providing two different frame footstools and special feet on the new stator. A compromise shunt and series field design for the stator made any of the old control in the various plants suitable for the new unit with only minor resistor changes necessary even in the most difficult case.

Fortunately, not many of our interchangeable spare problems are this complicated or probably we would not have many sane engineers left, but this example should show that perhaps even the most ancient and apparently hopeless case does have possibilities of solution. Of course the problem is considerably simpler on recently built machines and offers practically no difficulties when spares are bought at the time of the machine purchase.

As machine manufacturers we agree that there must be more protection against prolonged delays on main drive electrical equipment and there must be more preventive maintenance. We would like to help.

I. N. Tull: Harry Angel has given us a fine account of how his company, by means of standardization and slight modifications, provides spares for use in several locations with far less investment than otherwise. In fact due to the very expensive units covered, seldom is it possible to procure the money for purchase, and proper storage for such items for individual installations.

His remarks, pertaining primarily to large units, remind us that many smaller, auxiliary units need protection also.

The benefits to be derived start with the original design for installation. For instance, a certain number of spares of each rating of motors are a must to prevent delays on mills. A roller table or screw-down failure can usually be the cause of a nonoperating mill, as well as failure of the main drives.

For a minimum investment in electrical spares and proper accessible storage space for them (this has become in some plants a very difficult item to provide) a standard line of motors and their component parts are necessary.

Many times such items as pinions, half-couplings, brake wheels and pulleys are overlooked when engineered, even on new projects, and more so when additions to the originals are made.

If these items are not standardized too, then either a greater number of motors and armatures have to be

carried as spares than if the armatures are equipped with standard pinions, half-couplings, brake wheels and pulleys or much time and labor is wasted pulling off one and putting on another, usually under emergency conditions. A spare is not usable if it is not complete.

These requirements are easy to see on the job, while possibly not so apparent on a drawing board. In any event, if the maintenance, engineering and purchasing departments collaborate, there is no reason why such penalties cannot be avoided.

V. E. Holtslander: It has been the policy at Inland to provide a full set of armature coils for major d-c units instead of partial sets. Experience has proven, that in the case of units which have been in service for a long time and should a failure occur, a great deal of time is saved by having a full set of coils on hand. This is also true of stator coils and rotor coils for a-c motors. However, usually only two field coils of each type are provided as replacements for synchronous motors and d-c field frames.

Inland also operates on the common replacement principle. At times it is necessary to provide coupling and shaft extension assemblies, bearings and pedestal assemblies, plates for adjusting stator or field frame heights, etc., in order to use the replacement unit in various positions.

Inland also has a 7000-hp replacement armature which is used in the frames of main drive motors of our No. 1 and No. 3 blooming mills. We also have purchased a special well car for conveyance of this armature only. However, this car is stored empty inside of our No. 2 cold strip mill motor room. Therefore, our car problems are eliminated, and the special enclosure such as Mr. Angel described is not necessary.

We find, where possible, it is an advantage to have bearing linings for each replacement unit, and thus each unit will operate in linings which have previously been fitted or have had "run-in service."

Storage space is a very important consideration and sometimes is the influencing factor when deciding on a complete replacement unit or rewinding material.

It sometimes requires a large amount of research on certain applications whether it is more profitable to invest large amounts of money in spare units which may be needed at any time, in one year or in twenty-five years, or to shut the department down until the unit is repaired on an emergency basis. Business conditions at the time of failure, which may be unpredictable, makes the problem more complex. I would venture to guess many in the steel industry have been faced with this same problem.

I would like to ask Mr. Angel the following questions:

1. Are your coils specially treated for long storage before storing?
2. What method of storing is used—in racks or in boxes—and what method of fire protection is used for stored coils?
3. How do you arrive at a proper time to plan a rewind job on a major drive? Do you have any governing factors or do you conduct any tests to determine when you have obtained maximum life from your present windings and insulations?
4. Do you have a preventive maintenance program, whereby at periodic intervals you disassemble, inspect, clean, varnish and reassemble your major drive unit motors, or do you allow them to operate until a failure occurs?
5. What method was used in straightening the shaft you spoke of in your paper?

H. H. Angel: The spare coils we get are often protected with special insulation or packing for long time storage. However, if a set is ordered for use in the next year or so, it is not specially treated for long time storage.

The spare coils are generally kept in the original containers on a motor room floor or in a basement as far from combustible material as is possible. In some cases, strips of thin sheet steel are nailed around the boxes.

A rewind job on a major drive is planned only after considerable coil replacements have been made and it appears that the balance should be replaced as soon as possible or practical to avoid burning of iron and major delays. In some cases, where the insulation is very old and brittle, whether it be on armature coils or field coils, a rewind may be planned even though very little previous trouble has been encountered. We have not conducted any tests to determine when we have obtained maximum life from present windings. We have done some work on high voltage d-c testing, but have not started any major program up to the present time.

Our preventive maintenance program is probably similar to that used by other companies. Major units are inspected and blown out weekly. Every few months or so end covers may be removed for closer inspection and more thorough blowing out and cleaning, especially if Megger readings are low. Coils on a major drive are varnished or painted periodically, which may be every one, two or three years. Covers are first removed and the winding thoroughly cleaned. The rotor in an induction motor is moved only if inspection at the ends of the windings indicates the replacement of some wedges is necessary.

The shaft straightening process was a very complicated one. Heat for calculated duration of time was applied a number of times to certain portions of the bent shaft without the use of pressure. After cooling, new readings of shaft eccentricity were made, and heat of calculated duration was again applied at a definite point which was determined from a graph made by the engineer in charge. Final eccentricity was within five mils. ▲

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Pictorial Roundup

AISE Western Meeting

Los Angeles, Calif.

February 24, 25, 26, 1958

Record registration of 522 (1) was set at the Fifth Annual Western Meeting in Los Angeles. Local officers and committeemen met together to consider the formation of a Colorado section (2). AISE secretaries attending included Bob DuBois, Chicago; Jim Kinney, Los Angeles; Phil Ashurst, Detroit; and Tom Blakley, Utah (3). Local chairmen (4) included W. H. Kinney, San Francisco; Walt Harris, Utah; and Ruben Finkelstein, Los Angeles. In (5) are participants in electrical session on Monday morning, from left to right, Ruben Finkelstein, J. Raymond Erbe, Charles H. Zweifel, H. C. Diener, Jr., Louis E. Ringger, M. S. Rundel and R. M. Sills. Sessions were well attended (6). Other chairmen and authors get together at breakfast to plan the day's activities. In (7) are Otto Hoffmann, Emil Kern, Alex Krynytzky, James E. Trabits and W. H. Kinney. In (8) are Ernest F. Donatic, G. W. Teskey, Jr., Quentin M. Bloom, H. V. Schubert and F. J. McClain. Some of the authors in action are Emil Kern (9), Otto Hoffmann (10), R. M. Sills (11), H. C. Diener, Jr. (12), Joseph I. Greenberger (13), Edward B. Russell (14) and H. V. Schubert (15). In (16) are authors and chairmen for Tuesday afternoon session, Joseph I. Greenberger, D. E. Rea, W. A. Perry, R. L. Dowell, Edward B. Russell and Jerome L. Lindberg. AISE president, Leonard Larson is seen (17) flanked on the left by H. H. Fuller, president and W. J. McClung, vice president (steel plants), Bethlehem Pacific Coast Steel Corp. Other outstanding guests attending the meeting (18) were D. W. Lasell, general superintendent, Torrance works, Columbia-Geneva Steel Div., United States Steel Corp.; Barney Dagan, works manager, Kaiser Steel Corp., Fontana, Calif.; Ruben Finkelstein, vice president, South West Rolling Mills, Inc.; and Leonard Larson. Chief speaker at the stag banquet was Leonard Larson, president AISE, who is also chief engineer, Cleveland works, Republic Steel Corp. He gave a report on current activities of the AISE (19). In (20) R. J. Tremblay, general manager, Los Angeles plant, Bethlehem Pacific Coast Steel Corp., is between Emil Kern, first vice president, AISE on left, and Leonard Larson, president, AISE. The banquet was well attended with over 350 present (21). Speakers' table guests (22) included steel officials from the western area, past presidents of the AISE and AISE officers.

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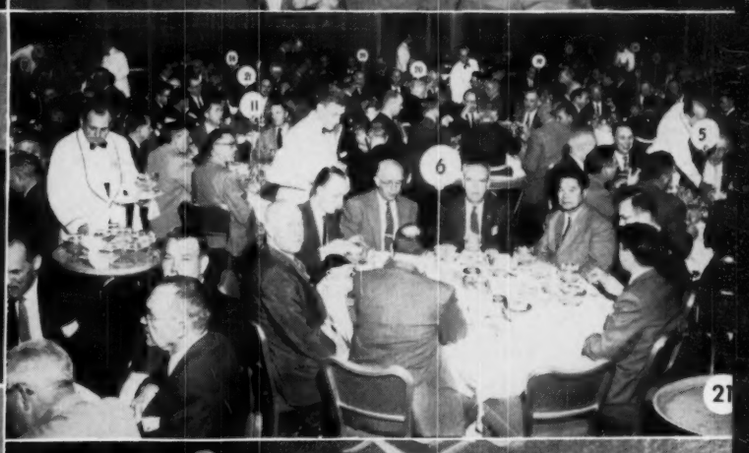
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OF IRON & STEEL
22

by SAMUEL CARSON, Field Engineer, Morgan Construction Co., Worcester, Mass.

Maintenance of Oil Film Bearings on

Separate roll and bearing shops are desirable for most efficient maintenance of modern high speed mills . . . . capable supervisors with qualified workmen, properly instructed in their duties, are also most essential.

MAINTENANCE of oil-film bearings in Europe varies from excellent to poor just as it does in America. Some of the modern European mills have benefited from experience on this continent and have started out with well-designed and adequate roll and bearing shops. They have introduced a few innovations that have resulted in improved conditions in bearing shops and lubricating systems, which will be discussed in this paper.

Figure 1 shows one of the newer mills in Europe which went into operation about three years ago to produce rod and merchant bar. In spite of the fact that they started with inexperienced personnel they have made excellent production records. Every stand is equipped with oil-film bearings of the type shown in Figure 2. More than two hundred of these oil-film bearings are efficiently maintained by two men on each turn. It is their duty to make all the bearing changes, make periodic inspections, record the tonnages rolled on each bearing and keep the bearings in condition.

When the rolls and bearings are removed from the mill housings, all the grease and mill scale is removed with a steam jenny before being transferred to the bearing shop. This simple task requires just a few minutes but has done very much to keep the bearing shops clean.

Figure 3 shows a section of the bearing shop for this mill. On the right are rolls from which the bearings have been stripped and on the platforms behind are the bearings waiting to be mounted on new rolls. In the foreground are rolls with bearings already mounted and ready for installation in the mill and in the left background are other bearings which have been set aside for inspection.

Bearings are shipped in boxes from the manufacturer in such a manner that they can be stored for long periods of time provided they are not disturbed. If the shipment is to be kept at the storehouse, some competent person from the proper department should be called in for approval of the shipment. If it is going directly to the operating department, it should not be opened until it reaches its destination where a proper storage place is provided. Excessive handling is eliminated and damage to parts is avoided. At the above mill an ideal storage place for many of the small parts is provided under the platforms seen in the background.

During the inspection periods each bearing is completely dismantled and every part is immersed in a cleaning solution, see Figure 4, which is agitated with air to make the parts totally clean without rubbing or wiping. On removal from the cleaning tanks, the parts are dried with filtered high pressure air which is moisture-free. The parts are never wiped with any type of towel.

Figure 1 — Oil-film bearings are used on this modern four-strand rod mill which went into operation in Europe about three years ago.

European Mills

With the exception of the bearing casing, all parts are next immersed in a rust preventive, see Figure 5, which leaves a very thin clear coating found to be beneficial in humid sections of the continent. After coating, the bearing is reassembled at the inspection bench, then moved to its place on the storage platform to await mounting on the new roll.

Three different sizes of oil-film bearings are used on this mill and the cross-section drawing of each size of bearing is framed and hangs on the wall close to the inspection bench. Alongside of the drawings is a large notice board for general use of the foremen and workmen. The inspection bench is halved by a partition from which the hand tools conveniently hang and the bearings are dismantled on one side of the partition to be reassembled on the other. Around the perimeter of each bench is a simple gutter made from angle iron and sloping toward one end of the bench. All dirt can be swept into these gutters and then into a pan under the low end of the sloping gutter, keeping the bearing area clean with very little effort.

Since bearing maintenance was improved at this mill, the oil loss is insignificant and contamination of the oil by water, which was high, is held below 1 per cent. The mill management is justly proud of the progress made. All departments have worked together to increase production, improve housekeeping and reach a better standard of maintenance, all at a reduced cost.

Figure 6 shows a modern skelp mill which is completely equipped with oil-film bearings. The decision to use this type of bearing was based on more than twelve years of experience with similar bearings on the smaller mill operating at the same plant where maintenance conditions were far from being ideal. On the author's first visit to the older mill, he found that the oil-film bearings were being stripped from the rolls, dismantled, inspected, reassembled and mounted on new rolls in a section of the mill building which was not very clean and where this work was done by using the crane serving the mill. He also learned that the water content of the oil was very high, but despite all of these adverse conditions these oil film bearings have operated successfully at low cost for seventeen years.

A new maintenance program was put into effect on the older mill and the water content of the oil was greatly reduced by making a few simple alterations. Today these bearings are operating with an oil having a water content of less than 2 per cent and often as

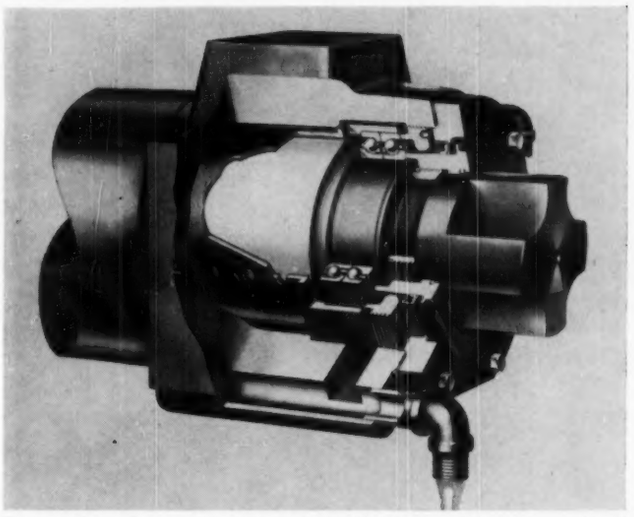


Figure 2 — Cutaway view of bearings used in the mill of Figure 1.

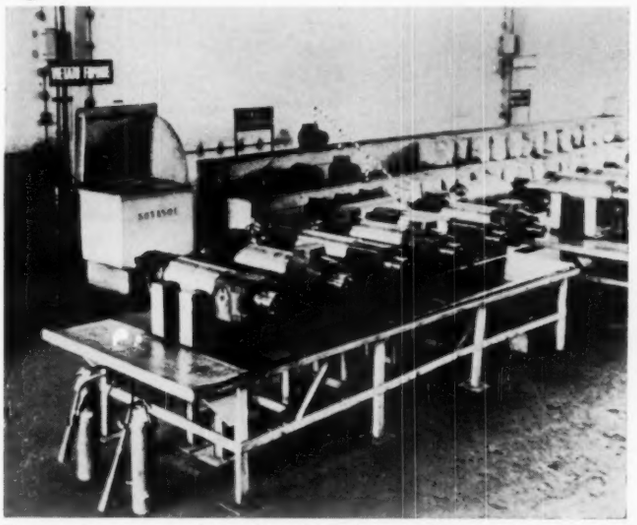


Figure 3 — A complete bearing shop helps service the rod mill.

Figure 4 — During inspection periods, bearings are immersed in cleaning solution.

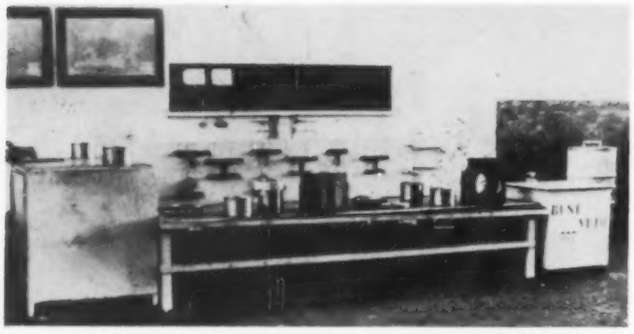


Figure 5 — All bearing parts are immersed in a rust preventive.

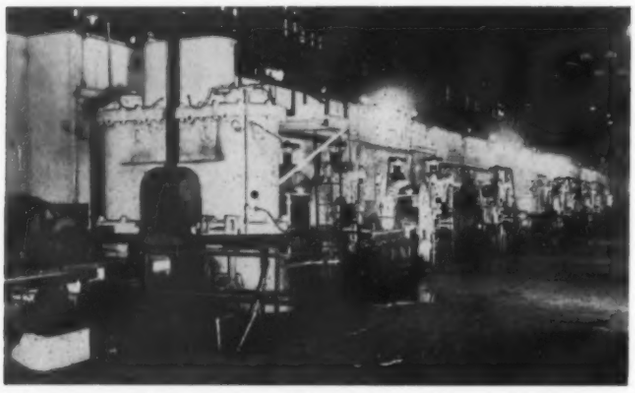


Figure 6 — This modern European skelp mill is completely equipped with oil-film bearings.

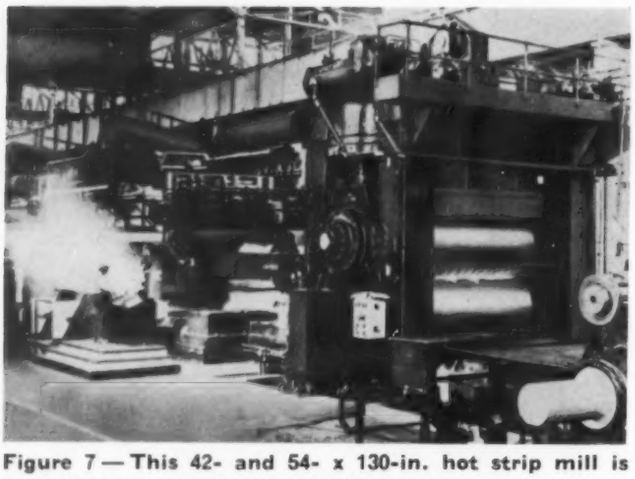
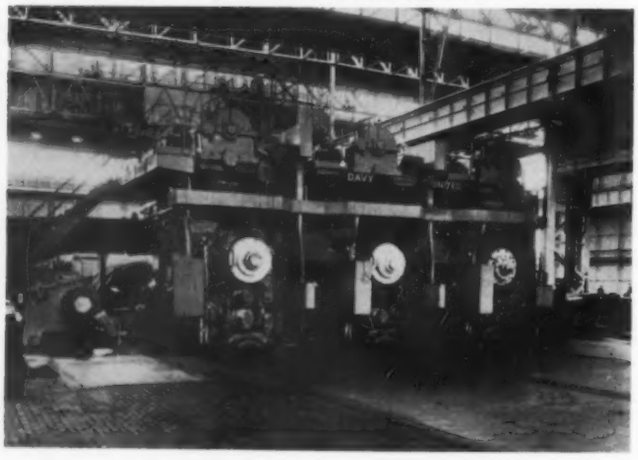


Figure 7 — This 42- and 54- x 130-in. hot strip mill is completely equipped with oil-film bearings.

Figure 8 — Shown here is three-stand tandem cold mill in Europe operating on oil-film bearings.



low as 0.2 per cent. The bearing maintenance is now performed in a separate shop where the workmen have their own crane and general conditions are much cleaner. Under these better conditions, the men have much more time for bearing inspection and correction of minor things which contribute to trouble. The program of improved maintenance has still a long way to go but reduced maintenance costs have already been achieved. Considering that the mill was originally built to produce 20 tons of steel per hr, later altered for 40 tons per hr, and is now producing approximately 45 tons per hr, credit must be given to the works engineer, whose perserverance has already accomplished so much without any major expenditure.

Figure 7 shows the broadside stand of a wide continuous hot strip mill which is completely equipped with oil-film bearings. An excellent schedule of bearing maintenance exists at this mill although conditions are not ideal. The roll and bearing shop has an area of approximately 29,000 sq ft, but this could be better used if the shop were wider. The roll shop superintendent, who has the fullest co-operation from the mill manager, has never hesitated to try ideas that might help him meet the demands of roll grinding and bearing maintenance, as steel production has increased. There are 92 oil film bearings used in this mill. The maintenance and inspection are carried out by one machinist and a helper on each shift with part-time help from a laborer to do some cleaning. At each roll change, the bearings are carefully scrutinized for damaged packings, seals, etc., and each part must be in order before the bearing is mounted on another roll neck.

Regardless of what is done at these times, the bearings are completely dismantled for a further inspection of each part at regular intervals. Anything unusual is reported and recorded along with the tonnages rolled on each bearing and the position it occupied in the mill. Today the superintendent has a complete record of the tonnages rolled and the hours of operation of every bearing, since the day the mill started several years ago.

The lubricating engineer introduced magnetic filters to the systems at this mill to remove the material which could pass through the normal filtrating system. As much as 7 lb of iron oxide have been removed from one magnet at one inspection. All efforts to eliminate this oxide from the oil had failed until the magnets were installed. Since their introduction, little difficulty has been experienced in separating water from the oil without the use of an emulsion breaker.

Figure 8 shows a 3-stand tandem cold mill operating on oil-film bearings at the same plant. There are also three 4-high single stand temper mills. The bearings for all of these mills are maintained by one machinist and a helper who make a complete inspection of each of the forty-eight oil-film bearings at regular intervals.

A new 4-high 4-stand tandem cold mill will soon go into operation at this plant. Figure 9 shows the modern inboard end design to be used which effectively controls oil loss and contamination by the rolling lubricant.

The lubricating oil is thrown into the sump by the rotating flinger and ingress of roll coolant is prevented by both water seal rings and conventional rubbing seals. During assembly of the older design of bearing, with one seal lip pointed toward the bearing and one

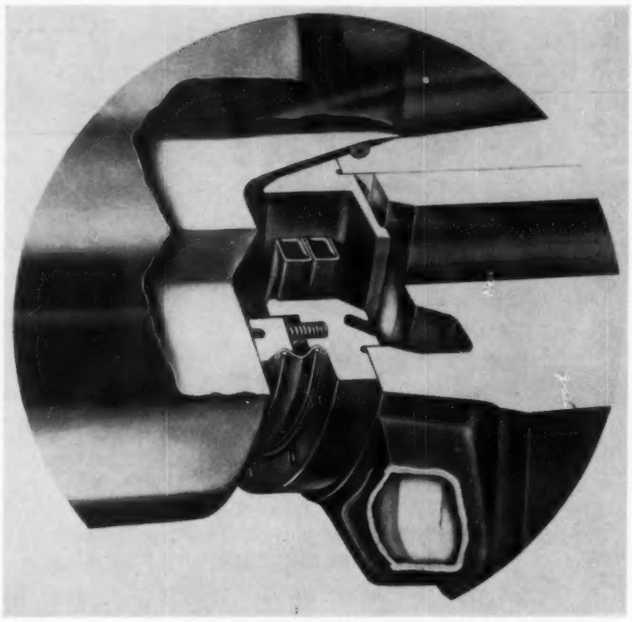


Figure 9 — Inboard end design effectively controls oil loss.

pointed towards the rolls, it was possible through carelessness to damage the seal pointing inwards. In the latest design both seals point toward the roll so that there is no longer a threat of damage to either seal.

Although better materials have been developed to lengthen the life of rubbing oil seals, the best of these will wear out. When that time comes the job of replacing seals has been greatly simplified because the seals are now fitted into a removable end plate and not into the casing. The seals can be replaced without completely dismantling the bearing.

Another material that has been improved is that used for the water seal boot. The first boots were made of leather, which was later replaced with neoprene. This has proved to be very satisfactory in most installations but left something to be desired on scalebreakers, slabbing mills, plate mills and other types of hot mills where there is always much hot scale which could burn through the neoprene fabric. The boots for these mills are now made of an asbestos fabric which is doing an excellent job.

The sleeve packing functions as a seal against leakage of the oil which passes between the sleeve and roll neck. This may be a very small amount, but like oils or greases from other sources can become a problem on temper or aluminum mills. For this reason the sleeve packing, which is an inexpensive piece of neoprene tubing should be replaced at each roll change. Like other types of gaskets in common use, it serves its purpose best when new.

The sleeve extension flinger design is so effective in preventing oil leakage that oil seals can be completely eliminated on mills that roll without coolant. This design as shown in Figure 10 has been very popular on temper and skin pass mills.

On the newest installations of lubricating systems, dual strainers are used as the main filtering unit. The baskets are made of stainless wire cloth with 0.0055-in. openings, and equipped with magnetic elements, and each is capable of filtering the full discharge of the pump. At a predetermined pressure drop, a hand-wheel is turned to open one strainer and close the other at the same time. There are no other moving parts and no by-pass is necessary.

The same type of strainer is used ahead of the pressure reducing valve at each mill stand except for the use of a cock instead of a valve. Experience to date

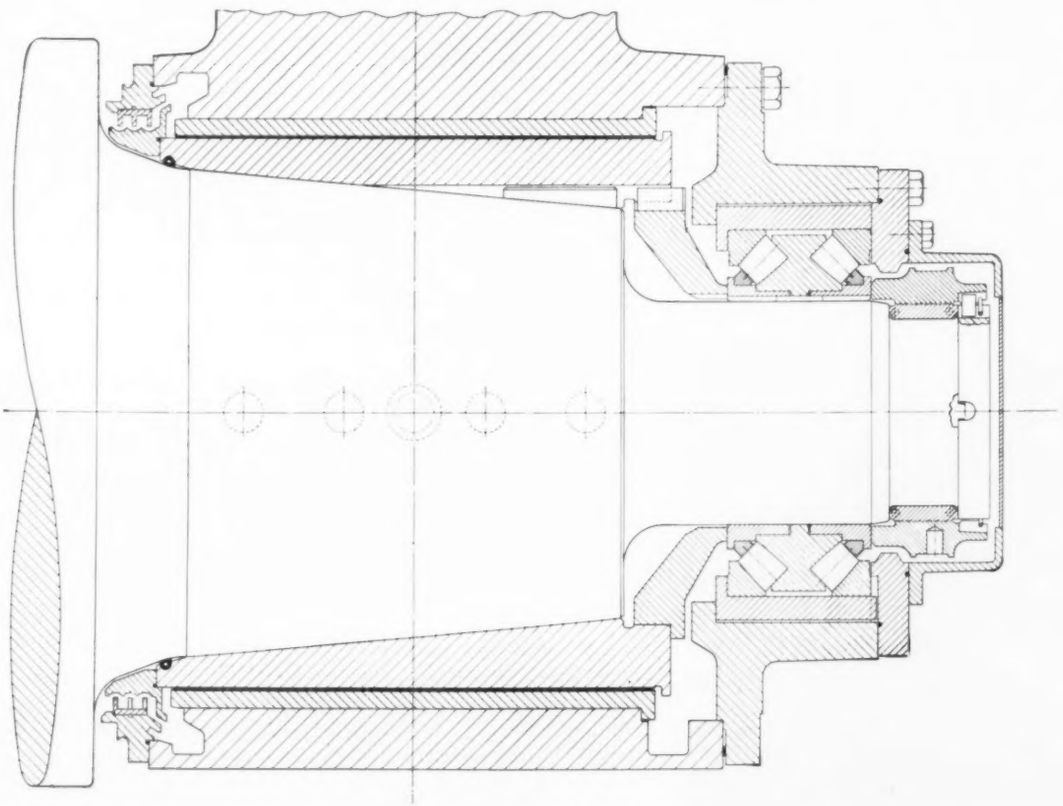


Figure 10 — This design incorporates latest improvements.

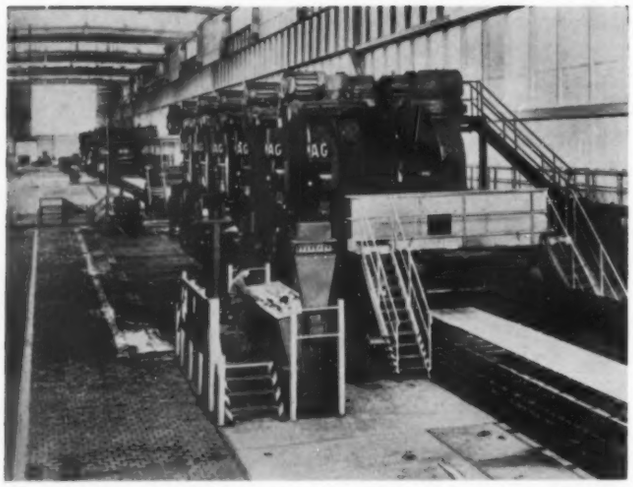


Figure 11 — A 37,000-sq ft roll and bearing shop services this hot strip mill.

indicates a definite improvement over the previous arrangement.

At a small aluminum foil mill in Europe there was an unorthodox piping arrangement which had one feature that has been copied to advantage. The supply line was installed with a trap at the foot of the housing risers and, when the plugs were removed a fair amount of foreign matter, which might otherwise have entered the bearings, was removed from the traps. Use of dirt traps at the point is now standard and experience has proven them an inexpensive but valuable addition to the system. They are particularly useful for removing foreign matter collected during flushing which heretofore remained in the system and undoubtedly caused occasional bearing failures.

Figure 11 shows a wide continuous hot strip mill which went into operation about two years ago. An excellent roll and bearing shop of more than 37,000 sq ft was provided for the mill. The attitude of the general superintendent with whom cleanliness is almost an obsession is well reflected in this photograph and also in Figure 12 showing a section of the roll and bearing shop.

Except for the size of the equipment the bearing maintenance and inspection at this wide hot strip mill is similar to that followed on the rod and merchant mill already described. In the foreground is a track over

Figure 12 — Ample room is available in this service shop.

which the rolls and bearings are transferred to and from the mill and in the middle of the picture is the area for bearing maintenance while the two grinders may be seen along the left-hand wall. Additional grinding equipment must be installed and the general superintendent has requested that with their installation the area of this roll and bearing shop be doubled.

Figure 13 is a closeup view showing the tank for cleaning the oil film bearings parts, the tank for cleaning the work roll bearing parts and the tank containing the rust preventive. Equally clean conditions exist in the roll and bearing shop for the cold mill at this plant where the 4-stand tandem cold mill and the single stand temper mill also operate on oil-film bearings.

Bearing maintenance has been made easier by the improved corrosion resistance obtained from aluminum alloy bushings. The low molecular weight fatty acids commonly present in lubricating system oils do not etch the aluminum alloy nor is there a detrimental build-up of soap compounds. Absence of etching and soap compounds has greatly improved the starting characteristics of mills stopped under load.

In one mill in Europe, the cooling water was brackish and they had rapid corrosive attack of the cadmium-nickel type bushings. Better mill operation and therefore easier maintenance has resulted from the use of the aluminum alloy bushings, which have shown no corrosive attack.

Since the aluminum alloy bushings are made from one piece sand or permanent mold castings, the loose bond troubles of bimetallic bushings are eliminated.

One of the mills using aluminum alloy bushings is probably the most modern 4-high plate mill in Europe, having two stands in line with all backup rolls operating on oil film bearings. Figure 14 shows the first stand of this mill with the rolls ready to go into the housing. An interesting situation developed on this mill in the summer of 1956 when the float bearing was reported as running warmer than usual on a Thursday. Operations were continued till Saturday when the bearings were removed from the roll necks during a scheduled roll change. It was then found that one roll neck was broken in a vertical line about halfway along the taper. The mill had continued to produce on-gage plate despite this complete break of the neck and without damaging the bearing beyond a slight chafing in the taper of the sleeve. This damage to the sleeve was so minor that it was sent to the factory, reground at a very nominal cost, and was back at the mill within ten days.

Although production on this mill is definitely limited because of the lack of raw material, recent schedules have exceeded 50,000 tons per month; 46 per cent of this production is $\frac{5}{16}$ in. or less with some of it being under $\frac{1}{8}$ in. Only 11 per cent is heavier than 1 in. thick.

Mill managers in Europe are taking a very realistic view of what is required for proper maintenance of all types of mill bearings. In answer to a questionnaire, ten managers of wide experience expressed desires for increased areas from 16 to 210 per cent of the existing space in roll and bearing shops. A study of their answers shows that on large strip mills, the space allotted for roll lathes, grinders, roll storage and bearing maintenance should provide 4000 sq ft per stand for hot

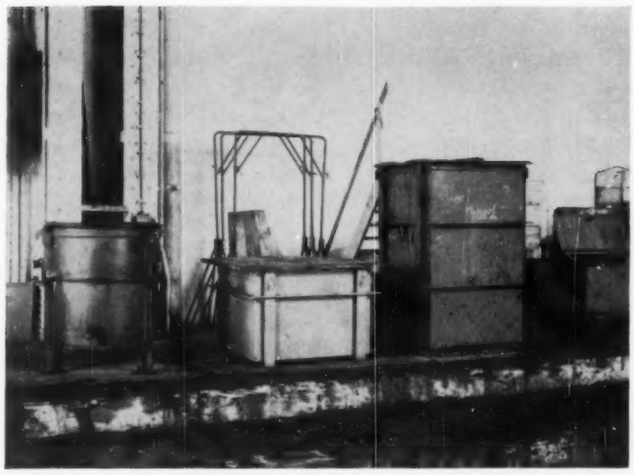


Figure 13 — Three separate tanks are used for cleaning the oil-film bearing parts, work roll bearing parts, and for handling the rust preventive.

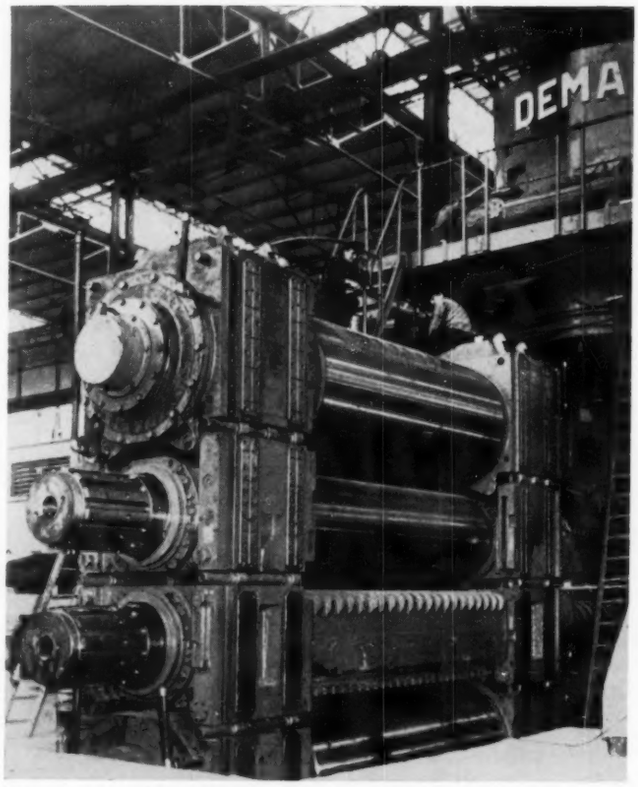


Figure 14 — Aluminum alloy bushings are used on this four-high plate mill which has two stands in line, completely equipped with oil-film bearings on backup rolls.

mills and 5500 sq ft per stand for cold mills. Considering the areas allotted by many companies for roll and bearing maintenance, these figures may seem great, but it must be remembered that they are the estimates of experienced mill managers who are very much interested in keeping true costs at a minimum. They recognize the need for a proper working area if rolls and bearings are to be handled efficiently in a minimum time at the lowest cost.

It is the author's opinion that better maintenance of oil-film bearings can be attained at reduced costs by retaining the good methods developed by ourselves, copying the good points of European origin and discarding the careless practices that are bred by familiarity. Judging from the desires of experienced European mill managers, there can be little argument with the opinion that roll and bearing shops are not given the careful consideration they should have in the original planning of a mill. Such shops should be separate from, but adjacent to the main mill buildings, having their own cranes and other facilities. It is undesirable to have a roll and bearing shop under the same roof as the production department, where the output of the mill often surpasses its highest expectancy and more area must be found for the increased number of coils.

In Europe, as in America, provision of a separate roll and bearing shop is, of course, no guarantee of good maintenance any more than the installation of a modern mill is a guarantee that faulty metal will not be produced. Capable supervisors with qualified workmen properly instructed in their duties are essential in both cases. Such groups of men will with experience find the ways and means of increasing their efficiency at reduced costs.

Discussion

PRESENTED BY

IRVIN J. LAMB, Roll Shop Superintendent, Fairless Works, United States Steel Corp., Fairless Hills, Pa.

A. G. HENRY, Superintendent of Maintenance, Tennessee Coal and Iron Div., United States Steel Corp., Fairfield, Ala.

D. M. CAMPBELL, Master Mechanic, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada

SAMUEL CARSON, Field Engineer, Morgan Construction Co., Worcester, Mass.

Irvin J. Lamb: From what Mr. Carson has just said one is apt to think that he has gone to the extreme and has been rather fussy on the cleanliness in the handling of oil-film bearings. However, I know that his long experience goes much further than the 20 years which have passed since I first worked with him on these bearings.

Although the rolling pressure is distributed over a large area, the oil film that separates the bearing surfaces must be kept free of contamination at all times. This involves rigid inspection both at the mill as well as the bearing shop. At the mill, keeper plates and clamps as well as the condition of the oil must be inspected periodically. In the shop, seals are inspected, replaced if necessary, the bearings replaced on rolls or stored in dirt-free containers.

What I am saying is but a re-emphasis of what you heard from Mr. Carson.

A. G. Henry: Mr. Carson stressed the importance of know-how, good housekeeping, cleanliness and proper working space as prime requisites in obtaining maintenance economy. I do not believe anyone will disagree.

In addition to these prime requisites, we have found that insistence on maintaining proper control of temperatures by adequate heat exchangers helps us economially by minimizing oil leakage caused by raising oil viscosity temperatures beyond reasonable limits. We automatically control oil temperatures between 95 and 105 F. Also oil pressure to the individual bearings should be maintained to the proper recommended limits to prevent excessive oil leakage by exerting un-

needed pressure against the sealing elements in the bearing assemblies.

Mr. Carson, what is your opinion in reference to these items?

D. M. Campbell: The maintenance of oil film bearings is of vital interest to all who service rolling mill equipment, and while conditions on this continent will vary from that of European such as operation, tonnage rolled, etc., it is paramount that a tight inspection schedule be followed.

There are one or two points which I would like Mr. Carson to clarify; after bearings are cleaned and inspected they are immersed in a rust preventative coating ready for assembly. What type of coating is used and does it have to be removed before bearing goes into operation?

Referring to a new maintenance program being put into effect on an older mill, where water content of the oil was reduced by making a few simple alterations, it would be interesting to know the nature of these alterations.

As nearly all steel mills set up a regular period for bearing inspection, it would be enlightening to those present to know how regular the bearings referred to were completely dismantled for a thorough inspection.

The removal of fine iron oxides from lubricating oil through the use of magnets is working very successfully in our mills, however, when it comes to water removal, we feel the best results are obtained by using an emulsion breaker.

Magnetic type line strainers are being installed on our new mills, however, standard type line strainers have been used for years on older mills, placed in the line close to the riser going to the bearing. We agree that the dirt trap described in the paper would be an added precaution.

The area assigned to roll and bearing inspection shops in many mills is inadequate, it is rather gratifying to note the area set aside for the hot strip mill described by Mr. Carson.

Samuel Carson: In answer to Mr. Henry's question regarding oil pressure and temperature we would point out that the oil for each application is carefully selected and its characteristics are specified to meet the rolling conditions of the mill. The oil is metered to each bearing through a special orifice at 100 F and at a pressure determined during the calibration. The temperature and pressure must be maintained within reasonable tolerances. The temperatures held at TCI are good although we know of installations where the temperature range is held between 98 and 102 F.

In answer to Mr. Campbell's first question I should explain that it was necessary to assemble bearings in very humid areas a long time before the start of mill operations. As a safeguard against corrosion we coated the bearing parts with solvent cut-back rust preventive which we have used in our own shops and which is soluble in oil.

Answering Mr. Campbell's second question I must point out that the mill with the high water content was equipped with oil-film bearings built in 1937 when sealing elements were incapable of standing up to the high peripheral speed of this application. With the installation of seals, made from the new synthetic rubbers, proper location of the mill water sprays and better maintenance of the water deflectors of the bottom bearings, the water content of the oil was reduced to a permissible amount.

It is almost impossible to give a direct answer to Mr. Campbell's third question because inspection periods will vary and must be determined by experience. In one mill in the Detroit area, there was an old mill which had not operated successfully on any type of bearing until oil-film bearings were installed. The previous schedule of inspecting bearings every few weeks was maintained after the oil-film bearings were installed although there was another heavily loaded mill with oil-film bearings in the same plant where the bearings were inspected once a year. Although the contrast may not be so great, there are many plants where the bearing inspection periods would vary from one type of mill to another. ▲

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Stream Pollution Reflects Operating Practices

by JOHN E. KINNEY, Sanitary Engineering Consultant, Ann Arbor, Mich.

. . . . to fully understand and solve the stream pollution problem, education is necessary to sell management on need of treatment; engineering on methods of treatment; and operating personnel on importance of program . . . .

IN the past ten years there have been some marked changes in the views of many people, companies, organizations and governmental agencies on the subject of industrial stream pollution. A very considerable influence on that change has been effected by representatives of the steel industry.

To understand what they did and how they did it, we must review a little of the background as of ten years ago. Following the Second World War, a concerted effort was directed towards clean streams. Sportsmen, conservation groups and civic groups decried the spoilage of our streams. Health groups and water treatment plant operators were vociferous in their complaints that sewage treatment was not adequate; that water plants were receiving untreated sewage. There was evidence that diseases other than typhoid, dysentery and cholera are transmitted by water. Better health demanded more adequate sewage treatment.

To complicate the picture, remember that streams flow across state boundaries. Pollution can thus be interstate. To control discharges from across state borders two approaches were undertaken: one by the Federal Government; the other, by several states developing a joint program.

On June 30, 1948, the Federal approach became a legal reality. On the same day nine states draining into the Ohio River formalized an interstate compact that was directed towards the same objective with the idea that the responsibility belongs with the states. This compact establishing the Ohio River Valley Water Sanitation Commission differed from other interstate compacts in that each state surrendered some of its police power to the interstate group.

Written into the law—a law approved by the eight states now members and by Congress and already tested in the U. S. Supreme Court—was the stipulation that all cities were required to construct at least primary treatment facilities for sewage. But it stated that because of different stream uses, flow conditions and other considerations, no single requirement could be fixed for industrial effluents. The framers of this new code also stated that the Commission should counsel with those it would regulate.

To help determine what requirements would be reasonable and necessary for the stream uses to be protected, the Commission invited individual companies in several types of industry to have management representatives form advisory groups to the Commission. Steel, metal finishing, oil refining, chemical, paper, coal and distillery groups were formed.

The committees were asked to recommend procedures by which their pollution problems could be defined and information with which the effects of those discharges could be evaluated. They were asked for an evaluation of the economic and physical limitations of existing treatment methods. To do this meant that the committees had to locate sources of waste, develop analytical methods to measure them, explore the possibilities of reuse of waste waters, modify process operations, and sponsor work in determining what is known of the effects of wastes.

One of the most active groups in this program is that of the steel industry.

WHAT IS POLLUTION?

Simply, their problem was to answer the questions: What is pollution from steel mills? What can be done to abate it?

What is pollution? To some, any sewer outfall connotes pollution. The sight of any industrial plant located on a river necessarily means polluted waters—waters carrying the oils, solids, cyanides, metals, acids of industrial processes—waters that ruin streams, kill fish, put tastes in water supplies.

But industry needs water to continue. And necessarily some of that water is contaminated by processing. Does abatement of pollution mean that no industrial water can be discharged to the stream?

State laws are intended to promote the general welfare. But sometimes they can confuse the situation. Many states have laws that forbid the discharge of any solids, liquids or gases that can be harmful. Without qualification this statement can mean complete prohibition of all discharges. Any substance in sufficient concentration can be harmful—even deadly. Too much distilled water can be lethal.

On the other hand an industrialist may consider that his sewer outfalls are harmless because, in his opinion, the waste load is insignificant. He will tell you that he is losing only one or two per cent of his product. He feels that since it is uneconomical to recover, it must be harmless.

Then there is the public concept of pollution. To most people what they can see, smell or taste is pollution. But it stops there. The same people who object to oil on the surface of their streams—and it should be noted that a quart of oil will be apparent as an oily sheen when it covers over one and a half acres of water surface—will object to paying a nickel a day for sewage treatment to reduce disease. They cannot see the bugs that can kill them.

The fishermen have another criterion. I have heard them lament the disappearance of game fish from so many of our streams—and because of industrial pollution. They forget that the sport fish need clean water and cool water. When the foliage along the banks of the streams was removed by the farmers, lumbering interests, highway or railroad construction and other causes, the means of maintaining cool waters disappeared. These same causes promoted silting of the streams and with the high turbidities came the fish that feel for food rather than see it.

These conflicting definitions of pollution show the need for reconciliation of ideas. None of them are all wrong—nor are they complete.

What is pollution? Pollution is too much of anything. Pollution exists when a subsequent use is harmed.

Drink too much and the body is polluted. Discharge so much waste to a stream that a downstream water use is interfered with and you have pollution. Even a sewage treatment plant can be polluted. Discharge of certain materials to the sewers can disrupt a sewage treatment plant when the concentrations are high enough.

So the group of steel company representative was faced with the problem of determining what constitutes pollution from a steel mill.

The sources of waste have been known, discussed and researched for many years: pickle liquor, mill scale, flue dust and phenol from coke plants.

But until the steel committee came into existence the efforts had been directed at reduction or, in the case of pickle liquor, there was hope of realizing a marketable product so as to recover money. Progress in the other three was indicated by greater reduction in losses to the river. The effects on the stream were assumed—not measured. It can be argued that there need be no measurement when a visit to the river shows islands of scale or flue dust: there is a need to reduce.

But reduce how much? That is the question that can be answered only by determining an effect on the stream or stream uses.

SOME PROBLEMS—SOME OBSTACLES

One of the first hurdles to be jumped was methods of analysis. And we are not over that hurdle yet. Ten years ago the standard methods of analysis were influenced largely by water and sewage plant operations. They were applied directly to the industrial effluents. Limitations were not realized. Many steel mills did not use these but other methods. Confusion was general. But until an analytical methods subcommittee was set up by the steel committee we were comparing data that should not have been compared because of the variation in procedure of analysis. The data were not comparable.

Then there was the problem of getting a representative sample. Unless the sample actually represents the flow, the data are no good. This can be one of the most difficult of the problems. There may be stratification in a sewer and surface sampling would then not reflect the heavy solids such as large scale that would move along the bottom of the sewer. Some processes are intermittent and unless the sampling is integrated with the operation the data are of little value. A great range in results too often convinces the analyst that the data are no good; unless there are errors in sampling or analysis, operating reports will usually explain the data.

There is, for some unknown reason, a tendency in waste disposal surveys to average results. There is no more justification for this practice than to excuse poor products off a line with the argument that on the average the products are good. Variation from the average can be the source of the pollution.

While on the subject of sampling, there is one more practice that deserves attention: sampling when conditions are ideal so as to report to management and the regulatory agency that waste loads are a minimum. Some scale pits are sampled only after cleaning, for instance. It takes little imagination to realize that regulatory agencies can check whenever they please, so that actually such sampling is harmful to plant management.

Another type of obstacle facing the committee was that of limits based on opinion or meager data but adopted by regulatory agencies as controls. An example: laboratory tests about thirty years ago were said to show that when the chlorine dosage is properly adjusted, as little as 1 to 2 parts per billion of phenol (i.e., 1 to 2 lb of phenol in 1,000,000,000 lb of water) will give a disagreeable medicinal odor and taste to water. The great effort to protect water supplies by limiting phenol concentration began.

Some states adopted limiting concentrations of phenol as controls. Coke plants installed dephenolizers or closed quench systems to reduce phenol discharges. But these devices did not always reduce the phenol concentration down to the recommended levels. Further reduction could mean fantastic expenditures. Was it necessary? That is the question that faced the steel group. In searching for the answer the committee learned much of interest. The role of phenol in taste and odor troubles is being developed. The group did not take the conclusions of some limited laboratory studies

as the whole story, but went to water plants, checked operating data, ran laboratory studies, measured phenol in the stream, checked complaints, traced sources of trouble and learned that the control of phenol was the shortsighted approach.

When the group looked at the objective—protecting public supplies from taste and odor rather than just attempting to limit phenol—they began to gather all necessary data to find the real causes.

Their findings have been submitted to the regulatory agencies. Discussion of the data is in progress.

In my opinion this approach—looking for the effect—has set the stage for one of the biggest accomplishments in the pollution abatement program. Considering odor as an entity and trying to find out what caused it rather than just arguing about the concentration of phenol present when it occurred has opened a new and positive approach to protecting water supplies.

In brief what they have learned is that dumping batches of material—whether it be the dumping of a tank of solution or cleaning out of equipment—causes trouble. If this same amount of material had been bled out over a period of time there would have been little or no trouble. The next time that any of you have occasion to clean out a naphthalene sump, final cooler sump or other material of high odor content—regardless of whether there is any phenol in it or not—remember that if it is going to a river some water plant will probably have trouble because of it. The same goes for discharges of oil.

Too often a lazy individual dumps wasted oil into sewers, scale pits or other places of easy access rather than carrying it to a dump or burning it. After a while the practice becomes standard and no thought is given to it. Or it may be that oil draining into sewers collects in scale pits or at manholes in sewers, and when the mill is shut down the water drops and a slug of oil hits the river.

Oil is objectionable for three reasons: it is evident; it can be a fire hazard; and it carries odors and tastes to water supplies. But it is also expensive. New installations and repair of existing equipment should be viewed considering possibilities of saving oil. The results can be eye-opening.

BASIS OF DESIGN

The suggestions that design should be considered in preventing slugs of odorous material from discharging to a stream or in preventing loss of oil can be paralleled in terms of other sources of waste.

Mill scale is no longer an all-inclusive term. Size of scale determines its settling characteristics. The law requires substantially complete removal of settleable solids. What constitutes settleable solids? The only term of reference available at present is one of settleability developed for sewage. There are obvious differences between sewage and mill scale or flue dust.

One company has made rather extensive studies on scales from different operations. The variability of particle size indicates that criteria for design of settling facilities will vary with source of scale. This same approach is being applied to stream studies so that the solids that will settle in the stream are defined. Other steel companies are moving into this program.

But this also sets the stage for design of process equipment to reduce losses of iron. Why not remove heavy scale dry rather than use large volumes of high-pressure water to move it to scale pits? Not only would all of the scale be recovered but it would mean that less water would flow through the scale pit. Less water means lower velocity. Lower velocity means more scale would settle. Greater recovery of scale, less water, smaller pits. Why not? It works. One steel company proved it. Others are now doing it.

Gas from blast furnaces carries solids. Part of these solids are removed from the gas in a unit called a dust catcher. Then more solids are removed by washing the gas. Solids are separated from the washer water in units called thickeners.

The dry dust recovery units are operating at about 65 per cent efficiency. They have for years. If the object is to recover dust rather than just to clean up the sewer outfall, why not give attention to redesign of dry dust collectors so that more dust will be recovered in the most usable form?

Why does the load of dust vary from plant to plant—from one operation to another? Bessemer and basic charges can result in different dust losses. The advent of taconite brought new problems. In some instances difficulty with binders resulted in increased dust. These variations are reflected in treatment or recovery operations. Thought given to reducing losses in operation can result in less treatment plant difficulties.

OPERATING CONSIDERATIONS

These operating difficulties must be recognized when treatment facilities are designed. In fact, unless treatment or recovery facilities are designed—rather than just ordered from some salesman or just constructed in similar manner to facilities previously installed—the results can be very disappointing.

But even the best designed facilities fail when the operating people do not understand their function or do not maintain them.

Pollution control agencies do not approve equipment. Their approval is based only on performance. A scale pit that is effective when clean can be completely unsatisfactory when filled with scale. Unless it is kept clean the construction costs are wasted. So also is the scale.

There are many valid reasons offered to explain poor maintenance of scale pits. To clean them may mean taking a crane out of service. The crane may be available but there is no car available into which the scale could be dumped. The pit may be inaccessible unless the mill is down. The cost of cleaning a pit may not be compensated by the scale recovered.

These reasons point up the need to plan the location of recovery facilities, to integrate their operation into the over-all production schedule and to appreciate the need for scale recovery.

They also point up the need for a new look at accounting of costs. Check your own company figures. Is recovered scale credited to the mill on the basis of its iron content or is there a fixed price per ton? Is the price per ton realistic? Does it act as an incentive to recover scale? Does it reflect the value of the ore which the scale would replace after sintering? If scale is purchased on the outside, how much is paid for it?

How much does it cost to clean sewers because the scale was not dropped in the scale pit? This cost must be considered. So also must the cost of replacing sewers when they plug from settled solids. Does your company dredge the river to remove solids that came from your outfalls? Is the cost proportioned to the various mills on the basis of their solids load discharged?

The point is this: waste disposal is not an isolated expense. Nor does the waste originate in any other place than in an operating process. Waste control properly belongs in operating control.

OTHER NEW LOOKS

Waste disposal as a step in process is recognized in other ways. Several steel companies are financing a pilot plant at Niles, Ohio, that may provide an answer to treatment of large volumes of sulphate pickling liquor. The principle involved is the regeneration of sulphuric acid from the iron sulphate and the recovery of the iron as an oxide. If it proves feasible, the installation of such a unit will mean integrating waste acid recovery with operation.

Cooling water for steel mills is used in very large quantities. Usually the source is a river or other surface supply. At times of heavy rainfall, the silt load in the river can be high and pumping such dirty water through the plant means pipe maintenance trouble. Improved settling devices for plant effluents can provide cooling water that is often of better quality than the river. Since water is one of the basic raw materials in the manufacture of steel, its supply is a step in process.

There are also new looks in methods of treatment of steel mill wastes. In existing plants space may be a most expensive commodity. To provide more efficient removal of solids, steel companies are sponsoring studies on magnetic flocculation of solids, magnetic separation of solids and separation of solids by centrifugal action. The first two are being tried on mill scale; the third has been tried in pilot plant scale on flue dust and the results have encouraged its trial on fine mill scale.

IDEAS NEEDED

These new approaches are encouraging. But they are directed at the treatment of waste products. If emphasis could be placed on reducing losses in production, there would be a two-fold accomplishment: reduction of losses of material and reduction of treatment costs.

But changes in plant practice or procedure are needed to accomplish this. Suggestions for such changes can be most intelligently supplied by those best acquainted with steel production.

There will be ideas when there is an appreciation that in many instances pollution abatement is largely a matter of conservation of material or control of operations; that waste disposal is a step in process; that changes in other steps in process may reduce or dispense with the need for waste disposal.

Give it your best thinking. The result cannot only provide cleaner streams and better community relations but also effect savings in production. Waste prevention is the most effective form of waste disposal. Waste prevention is everyone's business.

ATTITUDES AND APPROACHES

Operating controls or changes in operating procedures may reduce loads of waste to rivers. But the regulatory agencies cannot wait for those changes as the answer. Nor can they wait indefinitely for answers on actual effects of steel mill discharges on subsequent water uses. As municipalities and other industries reduce their waste loads, steel must do likewise.

Two courses are open: The first is to argue the difficulties of sampling and analysis, the lack of knowledge of the effects of the waste, the cost of sewer construction to collect wastes, the cost of treatment facility construction—and do nothing. The second is to recognize that the laws are going to be enforced and that eventually treatment must be provided and that if nothing is done until the orders are issued for construction by a given date the cost will be terrific.

In the state of Ohio any discharges to the river are made under the permit system which came into effect in 1952. It is only a matter of sufferance that the State is now in its annual permit renewals allowing the steel companies the opportunity to develop satisfactory methods from within. Realizing this sets the stage for intelligent control and design.

Fundamental to such a program is education of: management, on the need for treatment; engineering, on the principles of design to accomplish the objective; operating personnel, on the importance of the program and the necessity for its maintenance. Then there is one more group that needs education: the "do-gooders" who feel that industry is spoiling our streams because they will not spend the money to protect them.

The joint education will show factually:

1. That the steel industry as one of the largest users of water is interested in clean water.
2. That much can be accomplished even in old mills by modifying existing facilities to make them more effective.
3. That good housekeeping (not dumping dry scale, oil or other material down sewers) will reduce waste loads.
4. That construction of treatment facilities is a waste of money unless they are maintained.
5. That recovery of material can in many instances be profitable.
6. That, with many wastes, regulated discharge of wastes rather than batch dumping will protect our streams.
7. That the physical layout of some of the older plants limits construction of treatment facilities.
8. That methods of treatment satisfactory in one plant may not work in another because of different conditions.
9. That satisfactory methods of treatment are not yet available for all wastes.
10. That pollution abatement is everybody's business.

With this background the objective of stream pollution abatement can be understood and appreciated. The team approach will permit the adoption of a program that will show continuous progress at minimum expenditure. The accent on conservation will serve to pay for some abatement activities and reduce the cost of others that inevitably will be required under the increasingly stringent programs. ▲

A Combination Mill for rolling rod, bars and strip

. . . . unusual versatility has been incorporated in the new Carpenter mill which is ideal for their production of rod, bar and strip . . . .

by ERNEST E. DAVIS,
Superintendent Hot Mills,
The Carpenter Steel Co.,
Reading, Pa.

THE No. 4 combination mill at Carpenter was built to replace a much older cross-country mill that had reached its limit of expansion. Prior to the building of the new mill, much thought had been given to the revision of the old mill in order to modernize it to meet the growing demands for greater production and better quality.

Due to the limiting factors of the old mill building and old housings, plus the fact that to build on the site of the existing mill would mean a complete loss of production while the new mill was being built and the accompanying "bugs" worked out, it was decided to build a complete unit at a different location.

Because of the type of business of the Carpenter Steel Co., a flexible type of mill was desired. Small orders of high quality products emphasized the need that "downtime" be kept at a minimum. The demand for higher quality products meant that the new mill had to be capable of better surface, better tolerances, as well as greater production. In order to cover the full range of sizes, a different arrangement of stands had to be used than had been used anywhere before. The result was a custom-built mill, designed to meet the various exacting specifications.

The mill building is 650 ft long with a center bay [illegible] wide and two side bays, both of which are 50 ft wide.

The rolling mill is set up in the main bay while the side bays are used for motor rooms, maintenance shops, locker rooms and storage areas for billets, rolls and other materials used in the operation of the mill.

Two 20-ton cranes service the mill operations, one crane in the main bay and the other in the continuous furnace area of the side bay.

The building contains two basements, one under each side bay, where the various electrical equipment oil lubricating systems and air ventilating equipment is located. These two basements are connected by means of a tunnel underneath the mill through which conduits, water lines, etc., pass.

The building is ventilated by means of a continuous type gravity ventilator running almost the full length of the building. Fresh air is introduced into the building by means of blowers along the strip side of the mill. The reason for this is that the window area on that side is blocked off by the motor room and maintenance shops. These blowers also serve as cooling fans during the hot summer months.

The building is built of brick and corrugated asbestos siding to make it as fire resistant as possible. The roof of the center bay is also constructed of corrugated asbestos, but the side bays, because of their lower pitch, are roofed with precast cement blocks.

The mill layout (Figure 1) can be said to be of the "open triangular" type. It is called "open" because of the use of repeaters and loops from one stand to another as contrasted with the continuous mills in other plants.

It is "triangular" because of the flow of material through the mill.

The initial breakdown for all the mill products starts at the 2-high reversing mill. The strip flows straight down one side of the mill forming one side of the triangle. The bar sizes from ¾- up to 2-in. round cut across from the same starting area to finishing stand No. 5 and down to the hot bed and stationary shear. This forms the second side of the triangle. The coiled rods of the smaller sizes follow the same pattern, but cut back toward the strip mill to finish through a 3-stand continuous train of alternating horizontal and vertical stands. This forms the third side of the triangle.

The mill consists of a 20-in., 2-high reversing "baby bloomer," an 18-in. 3-high stand with a tilting table, 8 stands of 14-in., 4 stands of 12-in. and 10 stands of 10-in. mills.

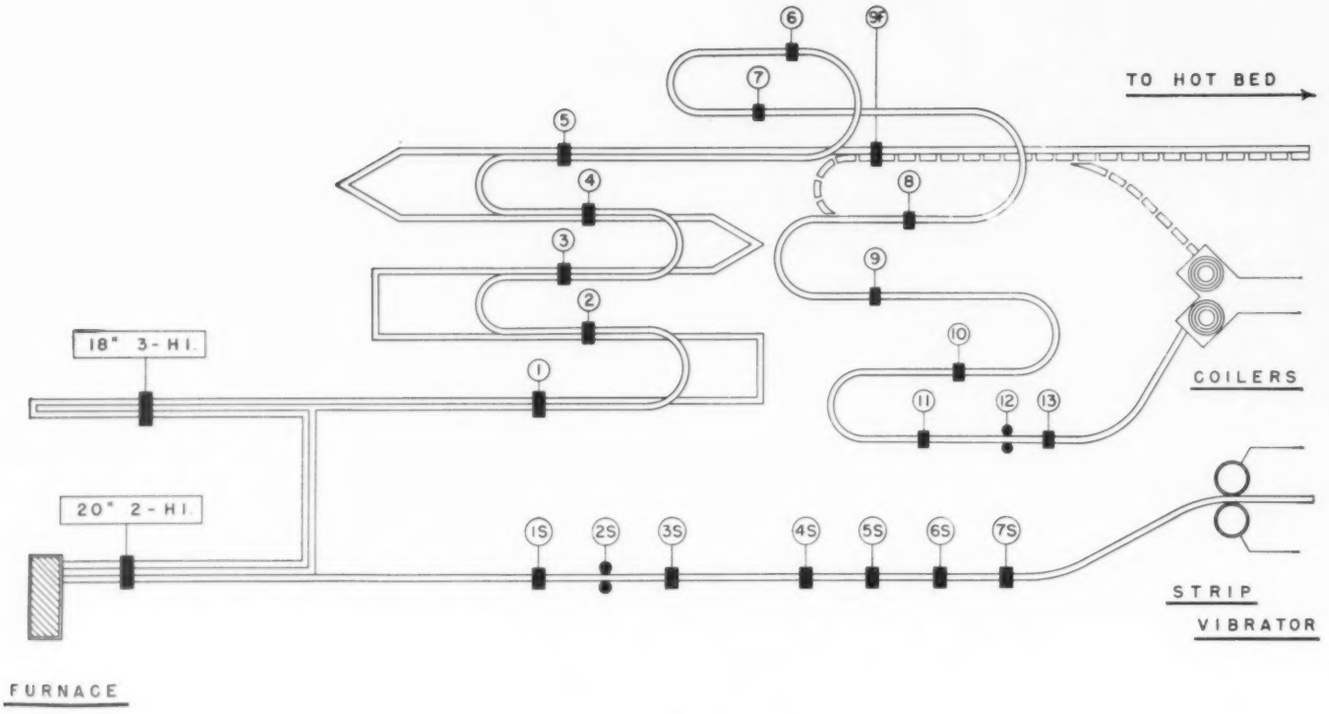


Figure 1 — Mill layout is of the open triangular type.

The 20-in., 2-high mill, which is used in all mill combinations, is equipped with a quick changing rig to facilitate roll changing and to keep downtime at a minimum. A water spray of 1000-psi pressure is used to remove scale during rolling.

Strip from 10 in. wide down to 3 in. wide is rolled on the 7-stand continuous 14-in. mill with one vertical edging stand (Figure 2). Drop loopers are used between the last five stands. They are air-operated from the control pulpit in front of and above the roll train. Upon finishing out of stand No. 7S, strip is turned on edge by means of a roller twister trough and vibrated upon a slat conveyor. It is then coiled on a horizontal coiler and transferred to a roller table from which it is deposited by means of an up-ender onto a coil holder. A boom truck transfers the hot strip coils to an industrial railroad car.

Each stand of the strip mill is individually driven as follows:

Stand No.	*Hp*
1	600
2 (Edger)	100
3	600
4	800
5	800
6	800
7 (Finisher)	600

Strip is finished at approximately 1300 fpm.

The slabs (Figure 3) that are used as billets for rerolling into strip are made from 9-in. ingots on the 2-high reversing mill. After rolling, they are taken by transfer tables and powered rollers to the 42-in. hot saw. After the ends are trimmed, the slabs are sent to the preparation department for grinding. All slabs are rolled to a uniform 3 in. thickness.

The bar mill (Figure 4) consists of one 14-in. stand and four 12-in. stands in conjunction with the 2-high reversing mill and the 18-in. 3-high stand. The 14-in. stand is driven by the same motor as the No. 1 stand of the strip mill through a 4-high pinion stand. The four 12-in. stands are powered in pairs by 600-hp motors through speed reducing units. Power driven rollers deliver the bar to the 14-in. No. 1 stand where it is turned by an automatic oval turner before entry. Transfer dogs are used to position the bar for entry into No. 2 and into No. 3 stands. Power driven rollers

Figure 2 — The seven-stand continuous 14-in. mill is used to roll strip from 10 down to 3-in. wide.

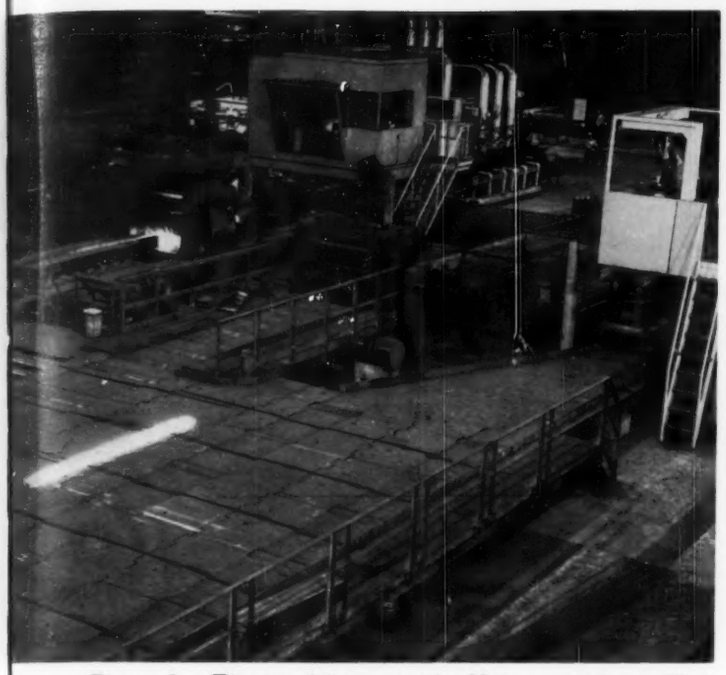


Figure 3 — The breakdown on the 20-in. reversing mill at upper left is very versatile.

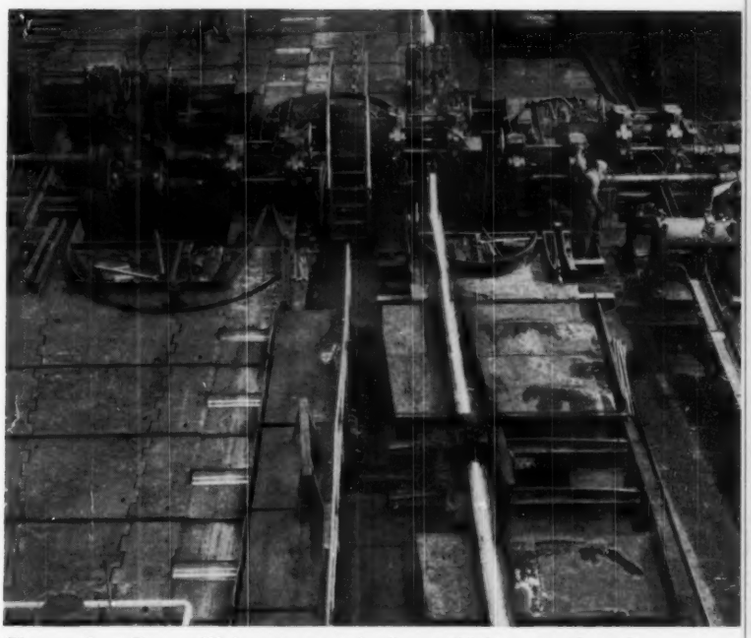


Figure 4 — Bar mill is composed of one 14-in. stand and four 12-in. stands used with the two-high reversing mill and the 18-in. three-high stand.

on each side of the mill deliver the bar to the entering stand. Two shifting chutes are used at No. 4 and No. 5 stands. These consist of a long trough equipped with a pinch roll drive. The bar enters the pinch roll drive, is stopped, transferred, turned 90 degrees, and delivered into the next stand on one continuous operation. A bar can enter one trough from No. 3 stand while another is being delivered from No. 5 stand. A hydraulically operated shear is used when necessary to crop the bar before entering No. 3 stand. All bar mill operations are controlled from a pulpit above and at one end of the mill. The finished bars are delivered by means of roller tables to a notch-bar hot bed. A flying shear is used to cut the bars to hot bed length, which is 108 ft. The bars are cut to mill lengths on an open type downcut stationary shear and deposited into the cradles for loading onto trucks.

There are three different rod mill setups to roll the various sizes of coils. The sizes $^{15}/_{32}$ in. round up to and including $^{55}/_{64}$-in. round are rolled on what is referred to as the "straightaway" setup (Figure 5). The No. 7 stand and No. 9F stand of the rod mill are moved over by means of hydraulic cylinders into a straight line with No. 5 stand of the bar mill. The sizes in this set up can be rolled either into bars or coils, whichever is required. There are loops between the "straightaway" stands during rolling.

For sizes $^{3}/_{8}$-in. round up to and including $^{29}/_{64}$-in. round, the rods are repeated through the bar mill and finished through No. 9F stand (Figure 6). These sizes also can be delivered either onto the hot bed for straight lengths, or into the coilers for coils. Looping of the finishing oval is done manually.

For sizes $^{1}/_{4}$-in. round up to and including $^{23}/_{64}$-in. round, the entire rod mill is used (Figure 7). These sizes are rolled only into coils. The rod is repeated through the mill from No. 1 stand to No. 11 stand. Manual looping is done at No. 11 stand in order to crop the rod when necessary before entering the continuous finishing train. The finishing train consists of two horizontal stands with a vertical stand between the two. The horizontal stands are moved hydraulically into line with the vertical stand. The vertical stand can be raised or lowered to make use of the entire roll face for grooves.

An air-operated drop looper is used between No. 11 stand and the vertical stand and a side looper between the vertical and finishing stands. A flying shear between No. 5 stand of the bar mill and No. 6 stand crops the front and back ends of the rods.

It is also possible to substitute a looping channel for the repeater from No. 8 to No. 9 stands. This is necessary at times in order to crop in addition to the crop

Figure 5 — Straightaway setup is used to roll $^{15}/_{32}$- up to $^{55}/_{64}$-in. rounds.

Figure 6 — Rounds from $\frac{3}{8}$ in. up through $\frac{29}{64}$ in. are repeated through the bar mill and finished in No. 9 F finishing stand.

at No. 5 stand. The mill is equipped throughout with roller guides, and all finishing stands of both the bar and rod mills are equipped with roller bearing end thrust adjustments. The continuous finishing train is also thus equipped.

Four re-heating furnaces (Figure 8) are used for billet heating to feed the mill. A continuous furnace with a capacity of 15 tons per hr feeds billets directly by transfer tables to either the 2-high reversing mill or the 18-in. stand. Three batch furnaces of 5-ton per hr capacity each are serviced by two small grab trucks. Both the continuous and batch type furnaces are automatically controlled and are heated by gas and oil.

Well equipped maintenance shops, both electrical and mechanical, are located in the side bay of the mill. The proximity of men and equipment, and the ability to quickly repair breakdowns, minimizes downtime due to mechanical and electrical troubles.

Figure 7 — Entire rod mill is used for sizes from $\frac{1}{4}$-in. up to and including $\frac{23}{64}$-in. rounds.

All pinion stands and gear drive units on the mill are lubricated from either of three independent strategically located oil systems. The oil, heated by steam coils, is circulated through the various loops as determined by the mill setup. Before entering the gear units the oil is passed through a cleaning filter.

Safeguards are provided to prevent starting any unit before the oil is circulating satisfactorily. Prior to switching from one mill setup to another, the oil is started through the next setup loop to assure easier starting of the mill units.

Full operation of the mill requires a total motor capacity of 9500 hp (Figure 9). There are seven 200-hp, three 800-hp, seven 600-hp, one 1250-hp, one 400-hp, and one 100-hp main drive motors. All electrical power for the main mill drives is supplied by motor generator sets. All auxiliary d-c power is provided by a mercury arc rectifier.

The motors and controls are supplied with filtered, cooled and recirculated air to insure efficient motor and control operations. The motors in the mill bay are cooled by the flow of air which is then exhausted into the open building.

All important operating points are connected by means of a two-way communication system. The operating pulpits, of which there are six, plus the eight auxiliary stations, are covered by loud speakers. A phone handset in each center can be used as a private line to any other center or as a "page" to cover the entire mill. The auxiliary stations include the maintenance shops, office, inspectors' workshop, furnaces and other important operating locations. Walkie-talkies are also employed by the maintenance men when they are working in areas not covered by the phone system.

The operating pulpit for the 2-high mill is entirely enclosed and air conditioned. The remaining pulpits are either partially enclosed or completely open. They are placed above the mill so as to obtain the greatest amount of vision for mill operations.

A recirculating water system consisting of three settling basins (Figure 10) is used to supply the mill water. The trenches under the mill stands are sloped to carry the water and scale to the main trenches which lead to the first settling basin. Scale settles to the bottom of the first basin and the clear water overflows into the second basin. From the second basin, the clear water is pumped back into the mill water supply system. The third basin is a standby basin. The equipment can handle 1500 gpm of water. Make-up water is obtained from nearby wells on company property. Recirculating the water not only conserves water, but also enables the company to comply with the State requirements for the disposal of industrial wastes in relation to the contamination of the Schuylkill River which flows alongside the mill. The scale is removed from the basins by means of drag conveyors. Inside the mill, drag conveyors are also used under the 2-high mill and the 18-in. stand to remove the heavy scale. Scale buckets are strategically placed for fast removal from the pits.

Since the mill has been put into operation, constant

Figure 8 — Four reheating furnaces are used to heat billets for the mill.

inspection has been made on tolerances. The performance has been fully satisfactory. Inspection records show that 280-lb coils of $\frac{5}{16}$-in. round rods are being held within the plus or minus 0.005-in. tolerance.

The end-to-end tolerance, which was a concern before the building of the mill, is also very good being 0.002 to 0.003 in.

Inspection records of coils of $\frac{1}{4}$-in. round rod showed the same results. Tolerances are checked constantly during rolling to assure superior products from the mill.

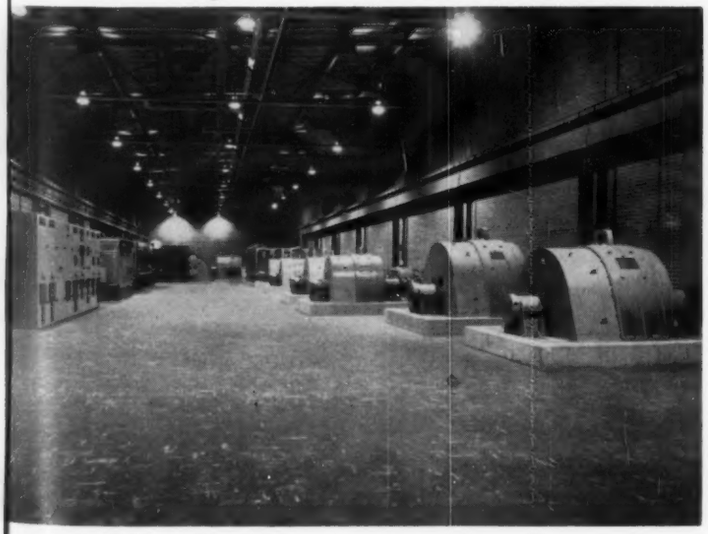
The production of the mill has been very good. With the wide variety of products, in upwards of 180 different analyses which the mill produces, the average production has been 50 tons per 8-hr shift. One of the main causes of lower production on any mill is, of course, the downtime due to roll changing and size changing. Rolling cycles are scheduled with the thought in mind of remaining flexible and at the same time to keeping downtime at a minimum. The general plan is to be setting up one part of the mill for the next group of sizes while rolling on another part of the mill. The mill is flexible to the extent that substitutions of sizes can be made on the strip changes, and break-ins can be made at any time the mill is made ready.

The size of the operating crew varies from 14 to 21 men, depending upon the mill setup. The total number of men in a crew, including supervision, clerks, inspectors and maintenance men, is 30. When the operating crew varies from setup to setup of the mill, the men not operating become roll changers for the next rolling category.

The mill is equipped with a large, central, modern shower and locker room (Figure 11) with ceramic tile walls and floor. In addition, auxiliary lavatories are located at convenient points in the building.

Modern safety devices of special design as well as standard practices are employed in the new mill. All precautions as to colored guards and markings on all possible danger points are taken to prevent injury to the working personnel.

Figure 9 — Main motor room shows row of 850-hp mill motors at right and electrical control panels at left.



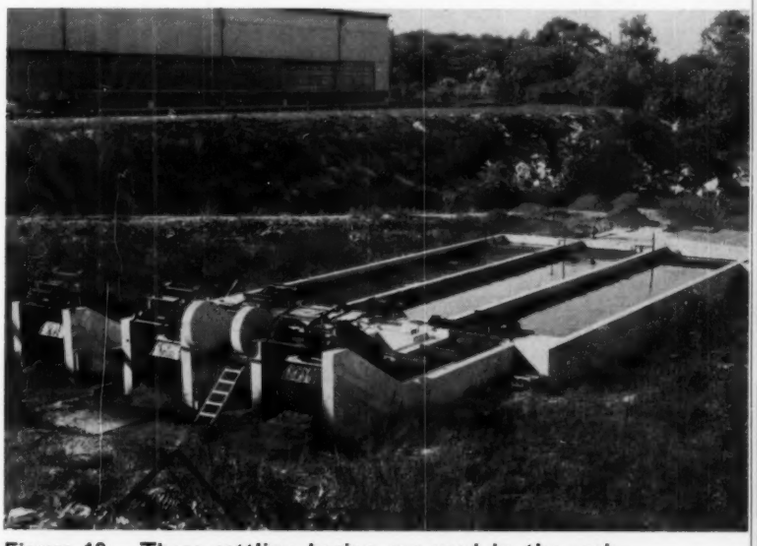
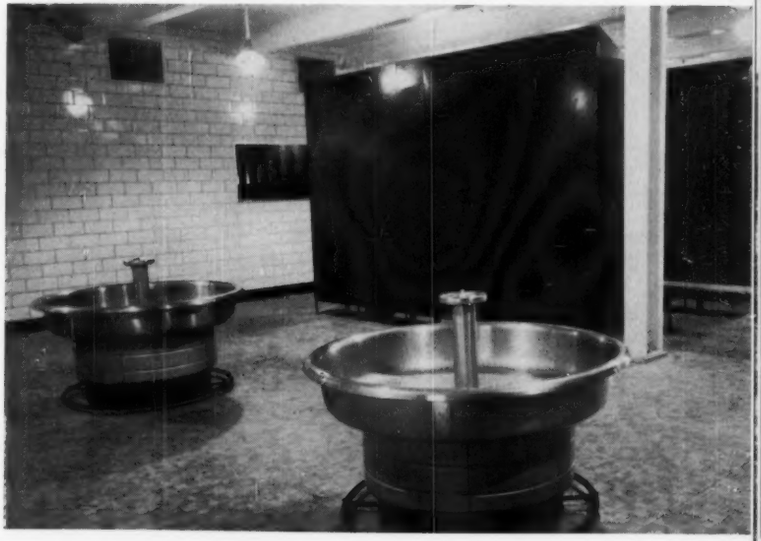


Figure 10 — Three settling basins are used in the recirculating system which supplies the mill water.

Figure 11 — Mill is equipped with a large centralized modern shower and locker room.



Discussion

PRESENTED BY

W. H. BOYLE, Superintendent, Merchant and Skelp Mills, Kaiser Steel Corp., Fontana, Calif.

E. C. PETERSON, Vice President, Rolling Mill Equipment Div., Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

C. E. PRITCHARD, Superintendent of Mills, Alan Wood Steel Co., Conshohocken, Pa.

ERNEST E. DAVIS, Superintendent Hot Mills, The Carpenter Steel Co., Reading, Pa.

W. H. Boyle: Where does he use the hydraulic water for cleaning the bar?

There is one thing, I would like to digress from this paper a little bit. A few weeks ago I had occasion to meet a Japanese in our plant who was going through for information, and I talked to him a few minutes. He was very much interested in rod mills, he told me that their mill was going 7300 fpm and had been in operation for three years. That astonished me.

E. C. Peterson: Mr. Davis, in his excellent paper spoke of the first 20-in. roughing stand as a "baby bloomer." Several bar mills have been built since the Carpenter mill, utilizing such a roughing stand, but Carpenter had one of the first, and it would be interesting to hear Mr. Davis' comments on the suitability of this type of mill for such application.

Concerning the main drive motors, it did not prove practical, except for No. 1 strip mill and 12-in. bar mill stand, to use the same motors to drive both the strip mill and the rod and bar mill although the possibility of doing so was investigated at some length. However, it can be noted that when rolling strip, 4300 hp, exclusive of the 20-in. mill is used, and when rolling rod 4200-hp, exclusive of the 20-in. mill is used; thus the 4000-kw, motor-generator set is fully utilized in both cases.

For the production of rod this mill replaced an old mill. It would be interesting to hear comparable statistics as to coil size, production rate and crew size, if they are available.

C. E. Pritchard: The extensive range of flexibility offered by a mill of this design undoubtedly introduces the need for a corresponding degree of flexibility of scheduling, roll changes, labor distribution of both operating and maintenance forces, and services.

Although the former are very well covered in this paper, it would be of interest to learn how the several combinations of mill arrangements are accommodated in regard to the application of roll coolant water; product coolant water for metallurgical control; steam and hydraulic water descaling spray, etc.

It is noted that drop loopers are utilized between the last five stands when rolling strip product. What gage variation is noted on strip product from end to end of the coil with this type of back tension control? What temperature drop do you encounter on the tail end of the bar going through the finishing train, on an average?

What maintenance problems have you encountered with the roller twister trough? How are the rollers lubricated?

Maintenance of vibrators on this type of service has always proved to be somewhat troublesome. What experience have you encountered in regard to both roll and drive maintenance at this location?

Movement of the formed coil to storage has always introduced the question of a satisfactory method of coil securement. How do you secure the finished coil prior to discharge from the coiler area and what success have you had to date in this regard?

Ernest E. Davis: In answer to Mr. Boyle's question of the droop, we have not noticed any droop at all, at least on the operating side of the mill, and I have not heard any of the electricians tell us anything different from the inside of the motor room. I think that is probably no problem.

The high pressure water spray is at the two-high mill, and in answer to Mr. Pritchard's question, too, in that respect, there are four lines coming into the two-high mill. For purposes of descaling we use only three. The fourth one is a matter of switching one of the three over to the fourth in order to get various combinations. It is possible to descale at three different times on the same product. Edging the slab, for instance, strip edging, and on the bullhead.

On round bars and rod we also descale at three different positions.

In regards to Mr. Peterson's comments, I find it very difficult when talking about this two-high mill to keep my enthusiasm under control. I honestly think this is one of the finest pieces of equipment that it has ever been my pleasure to work with. It is so completely flexible. We have a wide variety of billets. They range from 4-in. squares, $3^1/_2$-in. squares, $3^7/_8$ in. round, $3^3/_4$-in. round, practically anything you can think of and the mill is able to handle all of them without any difficulty at all.

Also, the various analyses that we roll call for different draft settings and that is handled very nicely without any trouble, so it is really a wonderful piece of equipment.

In comparison with the old mill, we found that we have increased our coil sizes. Our old mill handled 200-lb maximum coils and the average coil weight was about 135-lb. We rolled no wide strip.

In the new mill on just rod, we can roll 300-lb coils and we average about 235 lb on everything of the rod sizes.

Production rates, exclusive of strip, on the old mill was about 3 tons per hr, and on the new mill we have been able to increase that to 5 tons per hr average production.

As far as the crew is concerned, we set up a little different size crew but for comparison purposes we can take the rolling of $^1/_4$-in. round. On the old mill it took 29 men, on the new mill, we use 21; on $^5/_{16}$-in. round we used 27 men and in the new crew we use only 17; $1^1/_4$-in. round bars took 28 men on the old mill, and the new mill uses 17.

Mr. Pritchard asked some questions about the water. We have a main line coming into the mill up near the bar mill side and that main splits into two. One part of the main goes toward the roughing end, the 18-in. mill, the two-high mill and from there it goes down toward the strip line and at a point at the beginning of the strip line there is a valve and another line comes

across the bar mill. The second part of the main goes down toward the rod mill stands and down at the lower end it continues across and meets the first line making a complete loop. That, however, is valved there, and there is no connection unless an emergency arises that we have to change the direction of the flow.

By opening and closing two valves we alternate the water from one line to another. It works very easily and very fast.

The drop loopers mentioned also by Mr. Pritchard have worked very well. Front and back measurements on coils of the various sizes of strip shows practically no variation at all. At the most we have found a difference of 0.001 in. and this only occasionally. The temperature drop of the strip as it passes through the finishing stand averaged between 30 and 50 degrees F.

On the question on the roller twister; all the bearings of the rollers are brass bushings. We use stainless steel rods, because the trough is water-lubricated and that has not given us any trouble. Occasionally one of the bearings will go bad and we have to replace it, but that has not happened very often.

Of the pinch rolls we have two types. We use hardfacing on one set and spheroidal iron castings hardened and ground for the other set. I do not recall the hardness of this set, but it is flame hardened. These two sets of rolls are alternated from time to time in order to redress them. The vibrator itself has worked satisfactorily and we have been operating that unit about a year and a half now without any trouble.

Mr. Pritchard brings up a very interesting point when he starts talking about tying up coils. Tying up the round coils is no problem but on strip we have had quite a difficult problem. We tie up with round tie wire at the strip coiler. While the coil is still tight initially the handling that the coil has to go through from there on presents a problem until we get it onto our own industrial railroad trucks. The operators of the industrial railroad, I think, were the original "hot rodders," and we find that those tie wires break so very easily in handling. When you are trying to tie up coils of Carpenter Stainless No. 20 and A-286 you have quite a problem.

I have seen as many as fifteen tie wires break before the coil ever got out of the building and if the end sticks way up in the air you get a lot of complaints. That is still a problem and I would like to hear somebody that has a better way of tying than that. We have tried banding and it is not very practical. For one thing the coil is hot, and the tie men are on top of the coil and then you have a labor problem on your hands. To wait until you get down a little further on the table and band them, becomes a problem because you can no longer hold the end in place. So you have to tie it up when the ends are all in place and that is back at the reel. I am on the lookout for anybody that can come through with a device that can band right up there at the coiler in fast time. ▲

1958

AISE Convention and Exposition

CLEVELAND PUBLIC AUDITORIUM

CLEVELAND, OHIO

SEPTEMBER 23, 24, 25, 26

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Saturday, May 24, 1958—1:00 P.M.
Annual Stag Picnic
Pearl Lake, Birmingham, Ala.

BUFFALO SECTION

Tuesday, May 27, 1958, Dinner 7:00 P.M.

Annual Golf Meet (Afternoon)

Orchard Park Country Club, Orchard Park, N. Y.

CHICAGO SECTION

Tuesday, May 6, 1958, Inspection Trip 2:00 P.M., Dinner 6:00 P.M., Meeting 7:00 P.M.

Inspection Trip: Machinery and Foundry Div., Blaw-Knox Co., Railroad Avenue, East Chicago, Ind. Assemble at Plant at 2:00 P.M.

"Modern Rolling Equipment Illustrated," by David Lyle, Vice President, Engineering and Sales, Blaw-Knox Co., Foundry and Mill Machinery Div., Pittsburgh, Pa.

Dinner and Meeting, Phil Smidt's Restaurant, 1205 North Calumet Ave., Hammond, Ind.

CLEVELAND SECTION

No May meeting.

DETROIT SECTION

No May meeting.

LOS ANGELES SECTION

Monday, May 12, 1958, Plant Visitation 5:30 P.M.

Plant Visitation: American Can Company, 4815 Santa Fe, Vernon, Calif.

PHILADELPHIA SECTION

No May meeting.

PITTSBURGH SECTION

No May meeting.

ST. LOUIS SECTION

Wednesday, May 28, 1958—Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Planned Maintenance," by R. E. Stroppel, Plant Engineer, The Tool Steel Gear & Pinion Co., Cincinnati, Ohio

Elks Club, Granite City, Ill.

SAN FRANCISCO SECTION

Tuesday, May 20, 1958—Social Hour 6:00 P.M., Dinner, 7:00 P.M., Meeting 8:00 P.M.
Kaiser Steel Corp. Night

"1956 Expansion Program, Kaiser Steel Corp., Fontana, Calif.," Further details not available.

Shattuck Hotel, Shattuck & Alston Way, Berkeley, Calif.

UTAH SECTION

Monday, May 12, 1958, Social Hour 6:30 P.M., Dinner 7:30 P.M., Meeting 8:30 P.M.

"Overhead Cranes for Steel Mills," by Charles F. Simmers, Vice President of Engineering, Morgan Engineering Co., Alliance, Ohio

Grand View Cafe, Provo, Utah

YOUNGSTOWN SECTION

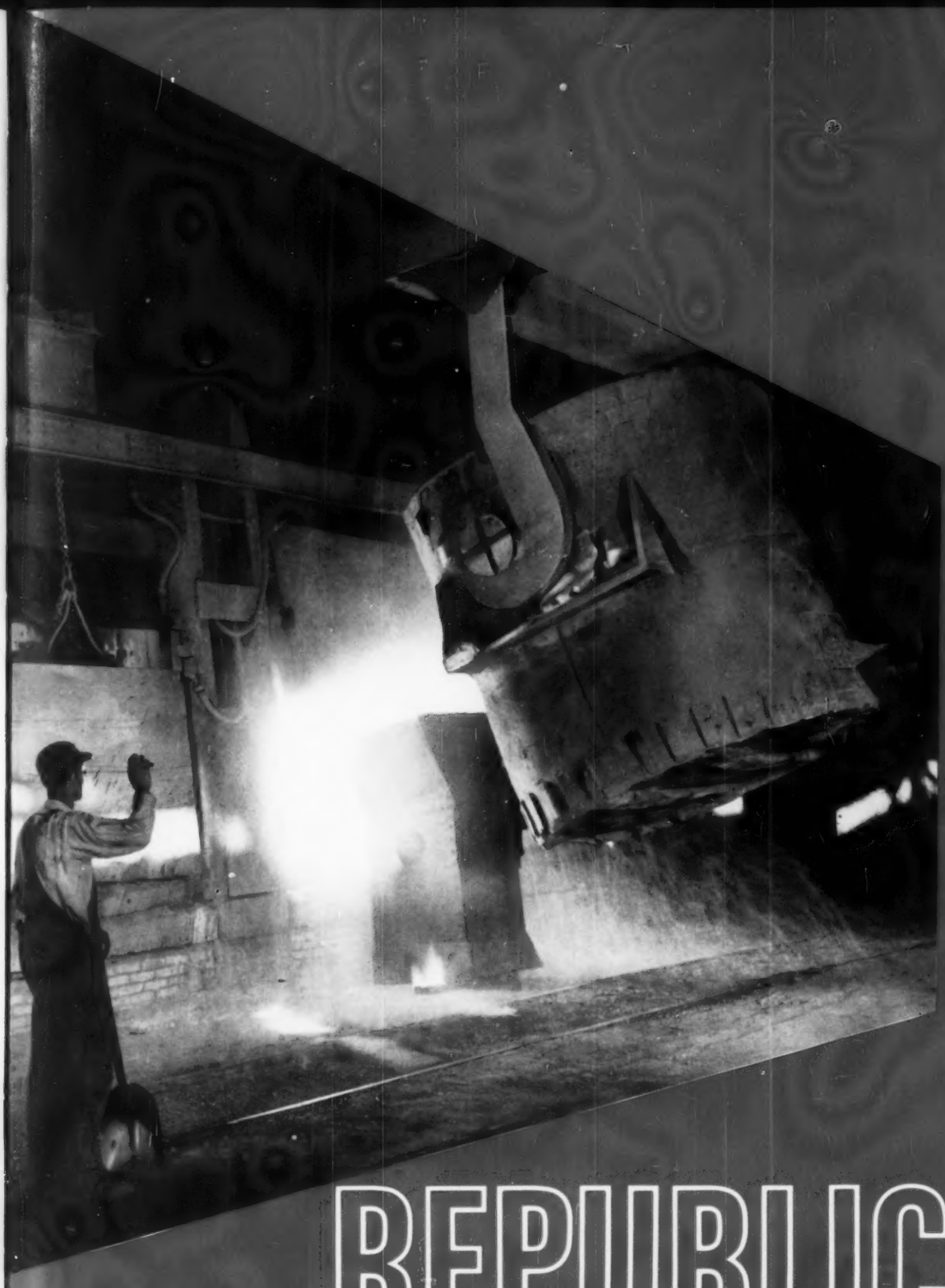
Monday, May 26, 1958—Inspection Trip 3:30 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

Inspection Trip: Youngstown Sheet and Tube Co., Brier Hill Electric Weld Tube Mill, Youngstown, Ohio

Election of Officers.

"Discussion of Plant Visit," Speaker from Youngstown Sheet and Tube Co.

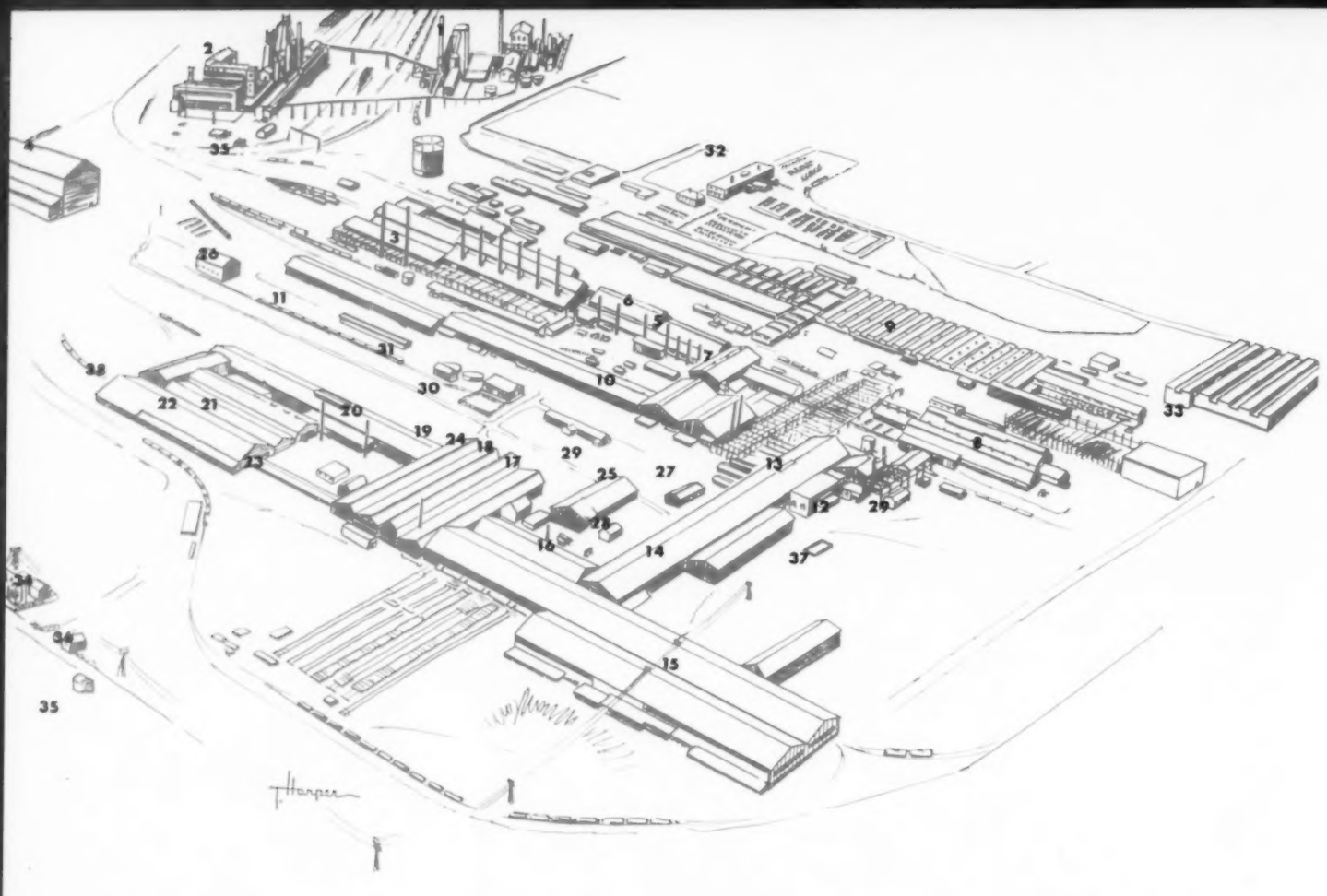
Dinner and Meeting: Mural Room, 225 W. Boardman, Youngstown, Ohio



REPUBLIC STEEL

REPUBLIC

in the South



1. Coke plant
2. Blast furnaces
3. Open hearth furnaces
4. Electric furnace
5. Soaking pits
6. New soaking pits
7. Blooming mill
8. Rod mill
9. Wire mill
10. Bar mill
11. Hot bolt and nut dept.
12. Slab heating furnaces
13. Plate mill
14. Hot strip mill
15. Pipe mill
16. Pickle line
17. Tandem cold mill
18. Annealing building
19. Temper mill
20. Galvanizing line
21. Hot strip cutting line
22. Slitting line
23. Cold strip cutting line
24. Cold coil storage
25. Roll shop
26. Foundry
27. Millwright shop
28. Canteen
29. Bathhouse
30. Water treating plant
31. Test laboratories
32. Main office building
33. Wire mesh plant
34. Power sub-station
35. Pump station
36. Back gate & truck scale
37. Scale pit
38. Transverse shipping bldg.

REPUBLIC

in the South

by T. J. Ess

NORTHERN Alabama has been blessed with generous deposits of all of the raw materials needed for the production of iron and steel. As a result, ventures into this industry began as early as 1815—and many of these ventures ended unfortunately.

The original nucleus of the present Gulfsteel unit of Republic Steel Corp. was one of these ill-starred efforts. In 1902 a Birmingham company, the Alabama Steel and Wire Co., established a plant at Alabama City, (now a part of Gadsden), 56 miles northeast of Birmingham. This company was reorganized as The Southern Steel Co. in 1906 and consolidated at Alabama City, and again reorganized as The Southern Iron and Steel Co. in 1907. In 1913 this property was acquired by a new organization, The Gulf States Steel Co., which, with progressive management, thrived and grew, developing into a well-rounded, fully integrated steel producer.

In 1937, the properties of Gulf States Steel Co. were acquired by Republic, bringing the advantages of a broader sales organization as well as making available added raw material reserves already owned by Republic in the Birmingham area.

Under Republic management, the plant has been expanded and modernized. New open hearth furnaces have been built, old ones enlarged. A bolt and nut plant and a wire mesh plant were put in, the plate mill was widened, soaking pits, heating furnaces and rolling mills were modernized. In 1942 and 1943 a new blast furnace and coke oven battery were built, both for Defense

Plant Corp. The wire mill was modernized and expanded in 1947, and a fusion welded pipe mill started up the following year. The most recent expansion, completed in 1957, included two electric arc furnaces, a continuous hot mill train for rolling strip-sheet, a cold reduction mill, a continuous galvanizing line and other modern finishing facilities for sheet products.

At present, the Gadsden plant has annual capacities for 565,000 net tons of coke, 525,000 net tons of iron, 789,000 tons of open hearth steel and 408,000 tons of electric furnace steel. Rolled product capacities include:

	Net tons per year
Hot rolled sheet	121,000
Bars	150,000
Wire rod	200,000
Skelp	215,000
Galvanized sheet	120,000
Plain wire	200,000
Barbed wire	23,000
Galvanized wire	80,000
Nails and staples	88,000
Woven wire fence	23,000
Bale ties	9,000
Electric fusion weld pipe	216,000
Plates (for pipe)	24,000
Cold rolled sheets	194,000
Nuts and bolts	12,000

Present capacity of the plant is approximately triple the capacity when Republic took over in 1937.

The general layout of the plant is such that material follows a smooth, uninterrupted course through the manufacturing process, with a minimum of handling and railroad shifting.

Republic also has a coke plant and blast furnaces at the Thomas plant at Birmingham, with annual capacities for 375,000 tons of coke and 402,000 tons of iron. These furnaces were established in 1888 by the Pioneer Mining & Manufacturing Co. and acquired by Republic Iron and Steel Co. in 1899.

Within short hauls of Republic's southern plants are found merchantable iron ores, a variety of coal, limestone and dolomite suitable for the smelting of iron.

Almost all of the iron ore for Gadsden and Thomas plants comes from the Birmingham district. Some ore from Labrador and Liberia also is used, the latter principally in the open hearth furnaces.

Ore is received at both plants by rail and is usually unloaded directly into the blast furnace stock bins. At Gadsden there are 15 bins of 342-ton capacity each, and 27 bins each holding 153 tons. Bin capacity at the Thomas plant totals 3800 tons. If necessary, ore can be unloaded into yard stockpiles, from where it is reclaimed by bucket cranes, loaded into railroad cars and taken to the stock bins.

Gadsden uses about 88,000 gross tons of iron ore per month, Thomas about 51,000 gross tons in the blast furnace and 14,000 gross tons in the sintering plant.

At present, all ores are purchased except the hard ore, which comes from the company-owned Edwards mine in the Birmingham area. Thomas sinter comes from the company's plant in Birmingham.

Coal comes principally from company-owned mines, the Sayre and Sayreton mines (Mary Lee seam).

Limestone and dolomite come from various quarries in the district, some company owned, some independent. For blast furnace use, the stone is sized 2 to 4 in.

COKE PLANT

Two batteries of ovens provide coking facilities at Gadsden to carbonize 2400 net tons of coal per day. One of these consists of 37 bottom-fired cross-regenerative ovens, 17 to 19½ in. wide, 39 ft-6 in. long and 9 ft-10 5/8 in. high. Each of these ovens takes a coal charge of 13.3 net tons of coal. Coking time is 17 hr. The other battery has 65 high-and-low burner, four-divided low differential regenerative ovens, 16 5/8 to 20 1/8 in. wide, 42 ft-7 3/8 in. long and 13 ft high. Each oven takes a 18.3-ton coal charge, and operates on a 16.6-hr coking cycle.

Coal is normally unloaded by shaker from hopper cars into track hoppers, conveyed to a 200-ton per hr coal breaker and discharged into two 180-ton mixer bins. It next is mixed by two steel pan conveyors, one geared to run twice the speed of the other. After passing through a 200-ton per hr hammer mill, the coal (80 per cent through a 1/8-in. screen) is conveyed to storage bunkers at either battery.

C. M. WHITE
Chairman of the Board

The coal mix averages about as follows:

	Per cent
Water	5.55
Volatile matter	31.75
Carbon	58.25
Ash	10.00
Sulphur	1.11

Normally, 145 ovens per day are pushed from both batteries.

A four-hopper larry scale car runs on top of each battery, conveying just enough coal for an oven charge from the storage bin to the ovens.

Each battery is served by a combination pusher, leveler and door machine. On the coke side of each battery, another door machine travels along the battery, handling the doors on that side.

Both batteries are underfired with straight coke oven gas, using 44.7 per cent of the total gas make.

Coke pushed from the ovens is handled by quench cars and electric locomotives to a quenching station that serves both batteries. Water for the quenching sprays comes from the primary coolers and is not recirculated.

After the quenched coke has cooled on the coke wharf, it is taken by belt conveyor to a screening station where it is put over a 4-in. scalping screen. The oversize is fed through a crusher. A double screen, 2½ in. on top and ¾ in. on the bottom, completes the separation. Nut sizes as well as the larger sizes are used as blast furnace coke, which runs minus 3 in., plus ¾ in. Breeze, which may be further separated into ¾ x ⅛ in. and ⅛ x 0 in., is sold or used in the sintering plant at Thomas works or in the direct reduction unit at Spaulding mine.

Furnace coke is moved to the blast furnace bins by belt conveyor.

Coal chemicals are recovered by conventional methods. Gas leaving the oven is subjected to sprays of cool ammonia liquor, condensing heavy pitch-like material and much of the tar. The condensed tar and liquor are collected in drain tanks and separated by gravity.

Under the action of two turbo-exhausters, the gas is drawn through four indirect primary coolers and then flows through electrostatic precipitators which remove tar remaining in the gas.

The gas then flows through a reheater, an ammonia scrubber and final cooler before passing through two light oil scrubbers, where the light oils are absorbed from the gas by wash oil. The gas then flows to three gas holders, two (20,000 cu-ft and 15,000-cu ft) holding fuel gas for the oven batteries and one 500,000-cu ft holder for surplus gas.

From the holders, fuel gas goes to the ovens for heating, while surplus gas is sent to the steel plant where it is used at the open hearth, soaking pits and slab and billet heating furnaces. Two centrifugal boosters move the gas through this distribution system at pressures of 5 to 7 psi.

The absorbent wash oil leaving the light oil scrubbers is put through a wash oil still, where steam removes the light oils. The de-benzolized wash oil is cooled and pumped back through the light oil scrubbers. The light oil is processed through refining equipment where it is fractionated into pure benzol, pure toluol and xylol.

BLAST FURNACES

Iron producing facilities at Gadsden consist of two blast furnaces, one of which was originally built in 1904, the other in 1942. Table I gives principal dimensions, as well as some operating data for these furnaces and for the two furnaces at the Thomas plant.

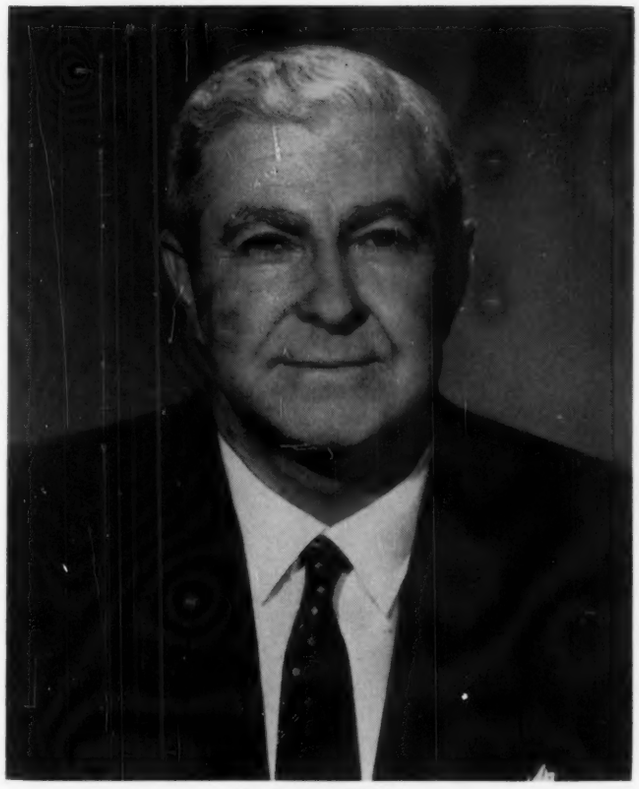
All of the furnaces have conventional cooling staves around the hearth, with copper cooling plates extending up through the bosh and well up (12 rows) into the in-

This 30-cu yd shovel is used in strip mining operations at Republic's Sayre coal mine.

TABLE I

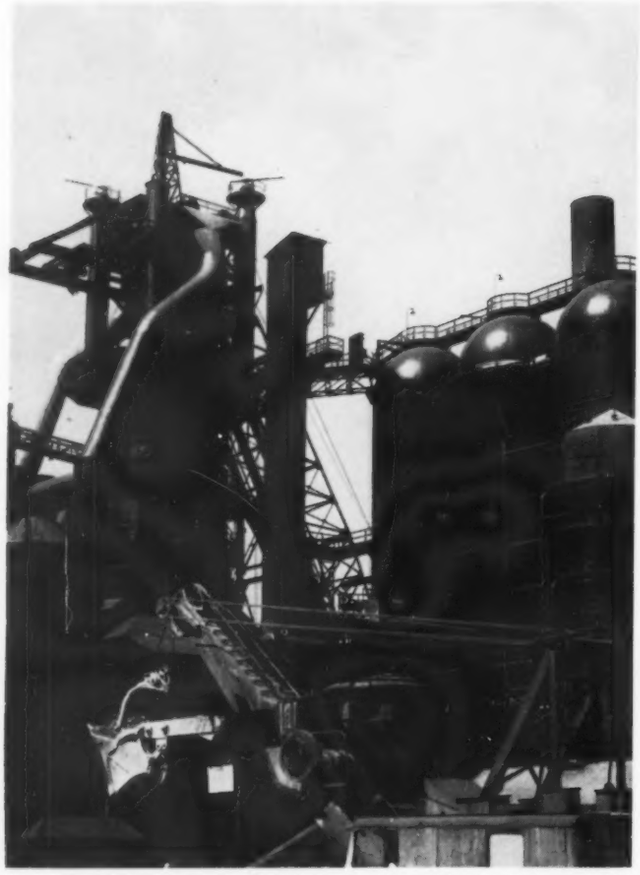
Blast Furnace Data

	Gadsden		Thomas	
	No. 1	No. 2	No. 1	No. 2
Diameter of hearth, ft-in.	17-0	24-3	17-0	17-0
Diameter of bosh, ft-in.	21-3	28-0	22-6	21-3
Diameter of stockline, ft-in.	16-6	20-0	17-0	17-0
Height, iron notch to top ring	89-8 7/8	105-9 1/2	88-7 1/2	89-3
Height of crucible, ft-in.	10-6	13-0	11-9	10-3
Height of bosh, ft-in.	12-6	11-9	14-8	12-6
Height of straight section, ft-in.	11-6	8-0	8-0	10-6
Height of inwall section, ft-in.	40-0	59-0	38-3 3/8	37-4
Height, stockline section, ft-in.	11-0 7/8	7-7 15/16	6-9 5/8	9-6
Height, bottom to iron notch, ft-in.	2-4	3-6	2-8	1-6 1/2
Height, iron notch to cinder notch, ft-in.	3-4 1/2	4-8	4-2	3-2
Height, cinder notch to tuyeres, ft-in.	3-3 1/2	3-4	3-10	3-10
Working volume, tuyeres to stock-line, cu ft	20,400	39,500	21,800	19,400
Bosh angle, deg-min-sec	80-21-0	80-56-0	79-18-0	80-20-30
Inwall slope, in. per ft	1.425	1.627	1.738	1.369
No. of tuyeres	12	16	12	12
Lining thickness, crucible, in.	40 1/2	31 1/2	40 1/2	31 1/2
Lining thickness, bosh, in.	22	27	...	32
Lining thickness, stock, in.	30	45	...	30
Lining thickness, throat, in.	33	48	...	22 1/2
Big bell diameter, ft-in.	9-6	14-5	...	...
No. of stoves	4	3	4	4
Stove diameter, ft-in.	20-0	25-0	21-0	21-0
Stove height, ft-in.	(2) 100-0 (2) 90-0	114-6 ...	89-0 ...	89-0 ...
Checker openings, in.	(1) 2x2 (1) 3 1/2x3 1/2 (2) 9x9	2x3 1/2	(1) 4x4 (3) 3 1/2x3 1/2 ...	4 1/2x4 1/2 ... ...
Heating surface per stove, sq ft	(2) 107,816 (2) 28,750	209,613 ...	57,750 ...	60,000 ...
Blast volume, cfm, average	54,000	75,000	54,000	...
Blast volume, cfm, maximum	60,000	90,000	60,000	...
Normal blast pressure at tuyeres, psi	20	25	24	24
Normal top pressure, psi	1,40	1.44	1.6	1.7
Normal top temperature, F	298	266	380	318
Lb of slag made per ton of iron	1800	1800	1750	1800
Ratio, stone to mix, per cent	19.5	18.5	16.2	16.2
Fuel ratio	2.19	2.34	2.08	2.08
Silica in mix, per cent	11.71	11.22	11.81	11.81



T. F. PATTON
President

Two batteries, totaling 102 ovens, provide facilities for coking about 75,000 tons of coal per month.



No. 2 blast furnace at Gadsden, with a 24-ft 3-in. hearth, produces 950 net tons of iron per day.

wall of the stack sections. Stocklines are protected by cast steel wearing plates set into the wall.

The Gadsden furnaces have carbon walls in the crucible 22½ in. thick in No. 2 furnace and 27 in. thick in No. 1 furnace, built of brick 13½ x 6 x 3 in. and 9 x 6 x 3 in. laid in carbon paste. These walls extend from the bottom of the hearth to 1 ft below the tuyere centerlines.

Each furnace has a conventional double skip, with the skip cars dumping into a revolving distributor top. The bells are operated by steam on No. 1 furnace and by air on No. 2 furnace.

No. 2 furnace is equipped with automatic charging sequence control. Ore, stone and coke are charged by weight.

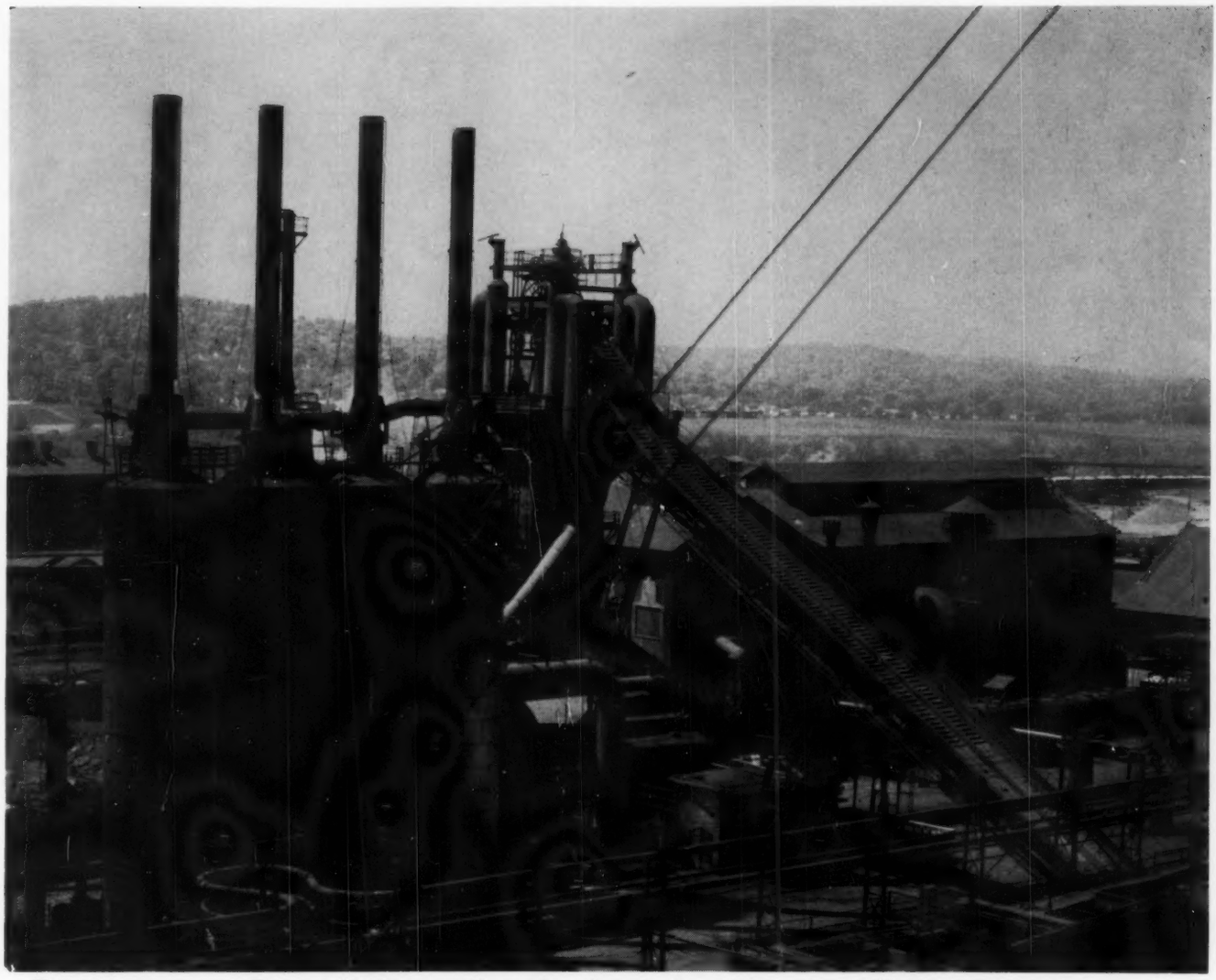
At the Gadsden plant, blast for the furnaces is supplied by three turboblowers, two rated at 60,000-cfm, 30-psi, and one at 90,000-cfm, 30-psi.

Blast is preheated in the stoves listed in Table I. All of the stoves are of two-pass, side-combustion design. Blast temperatures, automatically controlled by mixer valves, average 950 to 1000 F, with peaks up to 1100 to 1400 F. The stoves are fired with clean blast furnace gas through pressure-type proportioning burners. Stove cycles on No. 1 furnace are normally 1 hr on blast, three hours on gas. On No. 2 furnace stoves are on blast 2 hr, on gas 4 hr.

No. 1 furnace has two off-takes 5 ft-9 in. in diam which combine into a single downcomer leading into a dust-catcher. No. 2 furnace has four off-takes, 5 ft-6 in. in diam, which merge into two downcomers to a dust-catcher.

E. R. JOHNSON
Vice President, Operations

H. L. ALLEN, JR.
Assistant Vice President, Operations



The blast furnaces at Thomas Works normally produce foundry iron at the rate of 525 to 550 net tons each per day.

Each furnace also has a wet washer and No. 2 furnace is further equipped with two electrostatic precipitators. Gas from the wet washers ranges 0.099 to 0.15 gr of dust per cu ft of gas. The precipitator further reduces dust content to 0.005 to 0.009 gr per cu ft. Fine-cleaned gas is used in the stoves.

Water from the washers flows to a thickener, 110 ft in diam, and to a rotating filter. Sludge is stock-piled for future use.

Dry flue dust from No. 1 furnace is also stocked, while dust from No. 2 furnace is caught in hopper cars and shipped to the Thomas plant for use in the sintering plant there.

The furnaces are tapped every 5 hr into mixer type ladles of 125- and 150- ton capacities. Normally, basic iron is the principal product, but at times some foundry iron may be made. Iron analyses average somewhat as follows:

	Basic
Silicon	1.23
Sulphur	0.035
Phosphorus	0.70
Manganese	0.69
Carbon	4.17
Copper	0.08
Iron	93.00

The iron is used in the open hearth or electric furnaces, or pigged on a double strand machine.

Slag is drained into two-compartment dry slag pits. After solidifying and cooling it is removed by power shovel, loaded into trucks and taken to a conveyor which leads to a slag processing plant operated by an outside company.

Slag analysis runs somewhat as follows:

	Per cent
SiO_2	36.61
Al_2O_3	13.73
CaO	40.04
MgO	7.80
S	1.06
Mn	0.38

THOMAS WORKS

At the Thomas plant, in the northwest corner of Birmingham, there is one battery of 65 bottom-fired, cross regenerative by-product coke ovens, 15½ to 18½ in. wide, 42 ft-11 in. high and 12 ft-6 in. high. Each oven takes a 16.8-ton charge of coal. They are heated with coke oven gas, thus consuming about 40 per cent of the total gas make. A maximum of 100 ovens are

C. W. BARRETT
District Manager

T. H. HAGAN
General Superintendent

L. S. MOBLEY
Chief Engineer

pushed per day, providing capacity for coking 1680 net tons of coal per day.

Coal is received by rail, principally from company-owned mines, and is unloaded either directly into track hoppers or into a storage yard where it is handled by locomotive crane. About 10 per cent of purchased coal is used in the mix.

Coal handling, coke screening and handling and coal chemical recovery follow conventional methods.

Some surplus gas is used at the sintering plant and burned under boilers for steam generation.

Two blast furnaces, with a total capacity of 336,000 tons of iron per year, produce foundry iron for sale. Details of these furnaces are given in Table I. These furnaces are cooled by the usual hearth staves and copper plates in the hearth, bosh and about half of the in-wall section. No. 1 furnace has cast steel wearing plates in the stockline section. No. 2 furnace uses a 6-ft hanging skirt made in eight sections, 3 in. thick and reinforced with cast steel bars. No. 1 furnace at Thomas has a $22^1/_2$-in. carbon crucible wall from the bottom of the hearth to slightly below the tuyeres, of similar construction to those in the Gadsden furnaces. It is planned to put a similar hearth in Thomas No. 2 furnace on the next reline.

Each furnace has four hot blast stoves, with automatic control of blast temperature. Blast is provided by three turboblowers, rated respectively at 60,000-cfm, 40,000-cfm and 30,000-cfm. The drive turbines are equipped with barometric condensers.

The furnaces are cast every 5 hr and produce the standard grades of merchant iron used in the area.

Slag is flushed into pits, where it solidifies and cools. It is then removed for processing by an outside company.

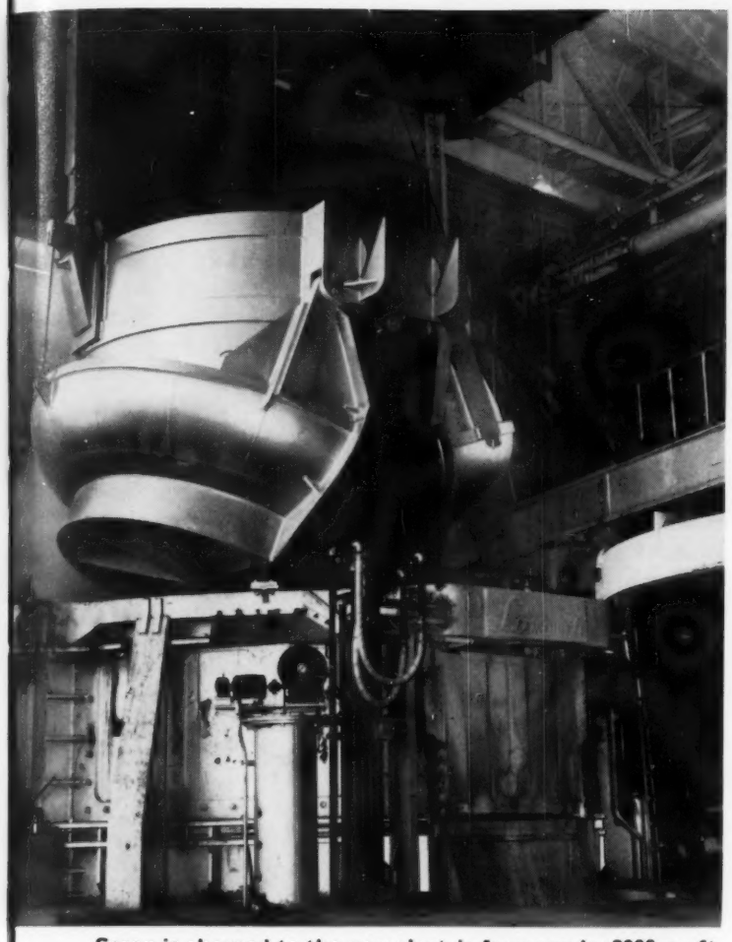
All iron is pigged for the foundry trade by a double-strand pig machine. Normally, the Thomas plant does not produce basic iron.

A 6-ft traveling grate sintering plant is installed to process dust and sludge from the Thomas furnaces, part of the dry dust from Gadsden, and some hard ore fines. It produces about 900 tons of sinter per day, which is used in the Thomas and Gadsden furnaces.

OPEN HEARTH

The open hearth shop contains eight basic furnaces with a total annual capacity of 789,000 net tons of ingots. The furnaces vary somewhat in size, six having been built for 75 tons in the original plant construction and two 225-ton units having been added. The six original furnaces have since been rebuilt and gradually en-

Steel is poured into a variety of ingot molds ranging from about 22 in. square up to as much as 23 in. x 52 in.



Scrap is charged to the new electric furnaces by 3000-cu ft, drop-bottom buckets.

The electric furnace shop is laid out to permit charging hot metal into the furnaces.

larged to the present capacity of 140 to 150 tons. Ratings and hearth dimensions are now as follows:

Furnace no.	*Capacity, net tons*	*Hearth, ft-in.*	
		Length	*Width*
1	145	35-11	13-3
2	145	36-8	13-3
3	145	35-8	13-3
4	145	36-7	13-3
5	145	41-1	13-9
6	145	35-4	13-3
7	225	52-0	16-0
8	225	52-8	16-0

All of the furnaces have sloping back walls.

Furnace roofs are of single sprung arch construction, laid up in zebra pattern in 4-ft sections with separating courses between sections. One course of basic brick next to the skewback provides a wearing strip. The roofs are 12 in. thick, with 18-in. ribs spaced on 3 ft-2 in. centers on the small furnaces, 2 ft-9 in. on the two larger furnaces. The back wall wearing strip is 15 in. thick.

The new furnaces, No. 7 and 8, are 83 ft–6 in. and 79 ft-4 in. over-all length, respectively, and 23 ft over-all width. Height from foreplate to bottom of skewbacks is 6 ft in front, 6 ft-4 in. in back. Two downtakes at each end of the furnaces provide about 80 sq ft area on No. 7 and 96 sq ft on No. 8.

Furnace bottoms are about 40 in. thick. A course of insulating brick is laid next to the bottom pan and topped with 4½-in. No. 1 fireclay brick, 18 in. of chrome brick and about 16 in. of rammed magnesite mix.

A single slag pocket is used on each end, about 17 x 12 ft.

Double regenerators are used on each end of the furnaces. They are about 25 ft long, 13 ft and 8 ft-6 in. wide and contain 15 to 16 ft height of checkerwork. This gives approximately 8310 cu ft of checkerwork on each end of the furnace. Checkerwork is laid in a basket-weave pattern, with 6-in. x 9-in. flues.

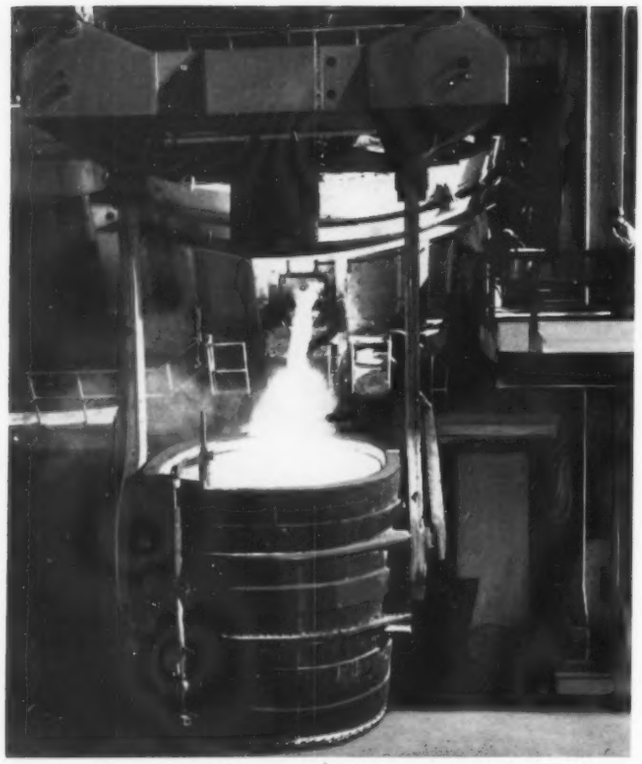
Vermiculite is sprayed on silica and walls, slag pocket bulkheads and regenerator bulkheads.

Open hearth fuel is a combination of natural gas, fuel oil and coke oven gas in proportions of 57, 42 and 1 per cent, respectively. The open hearth has dual loop recirculating systems, one for fuel oil and one for tar. Oil is heated to about 200 F and fed through the recirculating system from which the furnaces draw their requirements. Tar is seldom used in the open hearth.

The furnaces are manually controlled. Indicating, recording-integrating meters are installed for fuel and air flow. Three furnaces have radiation pyrometers which measure checker temperatures and ring a bell on maximum temperature, differential temperature or time, as desired. The other five furnaces have flue gas temperature measurement which sounds a bell on differential temperature.

Fans provide forced draft to each of the furnaces, which are usually operated at a positive pressure of 0.07 to 0.09 in. of water column.

The furnaces are charged with scrap and hot metal in proportions varying with the relative prices and avail-



The arc furnaces, 24-ft in diameter, turn out 200-ton heats in about six hours, charge to tap.

ability of each. Time of heats averages 12.3 hr charge-to-tap, 13.5 hr tap-to-tap. Tons per furnace-hour are 13.4 net, 12.2 gross. Fuel consumption averages 4,874,000 Btu per net ton of ingots.

Slag volume runs about 360 lb per ton of ingots. Slag is hauled in slag pots or dump cars to a dump, where it is processed and disposed of by an outside firm.

Rimmed steel is deoxidized with aluminum in the molds. For killed and semikilled grades, 65 per cent ferrosilicon is used in the ladle.

Steel made at the Gadsden plant goes primarily into wire, sheet, pipe, bars and small structurals. Grades are approximately as given in Table II.

Steel is poured into big-end-up molds 20 x 23 in. or 24½ in. square, of various lengths. Big-end-down molds run 21¾ in. square, 22½ x 35 in., 23½ x 46 in., 21⅞ x 43 in., and 22¾ x 52 in.

Molds are sprayed with a graphite solution before each use.

The open hearth shop consists of four adjacent buildings: a stockyard 840 ft x 72 ft with three 10-ton cranes and three elevated tracks at charging floor level; a lean-to 768 ft x 12 ft; a charging floor 768 ft x 63 ft-9 in. with one 100/10 ton crane and one 75/15 ton crane and three floor type charging machines; a pouring bay 768 ft x 55 ft-3 in. with three ladle cranes, one rated at 150/40/15 tons and two at 210/40/15 tons.

ELECTRIC FURNACES

Additional steelmaking facilities were recently added to the Gadsden plant in the form of two electric arc furnaces. Each furnace has a 24-ft diam shell of welded construction, 1¼ in. thick. Side walls are 13½ in. thick, with magnesite brick in the lower walls and metal-cased magnesite brick in the upper walls. The roof is 18 in. thick, using silica brick. Expansion allowance of 3/32 in. per ft is provided by using wooden and cardboard spacers in building the roof.

The furnaces are supported on rockers and are tilted for tapping by hydraulic cylinders actuated by motor-driven pumps.

Each furnace uses three 24-in. graphite electrodes supported by a movable mast actuated by an electric motor. The 25-hp electrode motors are controlled by adjustable voltage control, using rotating regulators.

Power is brought to the electrodes by lead cables, each phase composed of 32 flexible 1,750,000-circular mil cables.

Each furnace is provided with a three-phase, 36,000-kva oil-immersed, water-cooled transformer, the largest thus far applied to arc furnaces. Primary voltage is 13,800. Secondary voltage steps are arranged to give 545, 520, 495, 470, 440, 415, 395 and 375 on delta connections and 314, 300, 286, 271, 254, 239, 228 and 216 on wye connections. Motor-operated tap changers are provided, controlled from a dead front operating panel. An air circuit breaker, rated at 13,800-volt, 2000-amp, and 23,000-volt, 2000-amp motor-operated disconnect switches are installed on the primary side of the trans-

TABLE II
Typical Analyses of Steel Produced

End Products	Kind	Composite analyses of heats by grades					
		Carbon	Manganese	Phosphorus	Sulphur	Silicon	Copper
Manufacturers' wire	Silicon killed	0.147	0.443	0.020	0.034	0.185	...
Wire mesh and mfg. wire	Rimmed	0.089	0.362	0.017	0.032	...	...
Coat hanger wire, roofing nails	Rimmed	0.042	0.314	0.013	0.029	...	...
Fence wire	Silicon killed	0.103	0.413	0.018	0.033	0.180	...
Bolts and nuts, rivets and mfg. wire	Rimmed	0.128	0.434	0.020	0.031	...	...
Bolts and nuts, rivets and mfg. wire	Semi-killed	0.176	0.462	0.021	0.032	...	...
Welding wire	Rimmed	0.124	0.485	0.014	0.026	...	0.125
Bars	Semi-killed	0.210	0.407	0.023	0.029	...	...
Reinforcing bars	Semi-killed	0.339	0.466	0.026	0.028	0.064	...
Structural grade bars	Semi-killed	0.197	0.411	0.019	0.031	0.069	...
Structural grade bars	Rimmed	0.146	0.421	0.023	0.034	...	...
Sheared plates	Semi-killed	0.154	0.451	0.019	0.033	0.072	0.17
Pipe	Semi-killed	0.233	0.854	0.023	0.028	0.075	0.17
Sheets	Rimmed	0.088	0.377	0.102	0.031	...	0.17
Sheets	Semi-killed	0.090	0.370	0.080	0.031	...	0.22
Merchant rods for nails	Semi-killed	0.366	0.663	0.023	0.025	0.073	...
Bars	Semi-killed	0.390	0.780	0.022	0.023	0.079	...

former. Each transformer has a reactance of 4.26 per cent.

The furnaces are equipped with a unique demand computer to assist in holding power demand at a minimum. This device consists of a computor installed near the incoming power meters, an auxiliary computor that dictates the permissible demand level, and a large indicator dial with two pointers, one showing the average rate of power use in per cent of the established high demand and the other, the elapsed time in the demand interval. Signal lights emphasize the indicator movement—a red light shows when the rate of use, if allowed to continue, would establish a new high demand; a green light indicates that the rate of use is under the established high demand.

The arc furnaces are top charged. The roofs are designed to be lifted and swung aside by hydraulic power. Drop-button buckets of 3000-cu ft capacity, handled by overhead crane, bring scrap to the furnace.

Using a single slag, the electric furnaces produce the same range of products as made in the open hearth. Heats are turned out in 6 hr., charge-to-tap, giving a production rate of about 30 tons per hr. Oxygen is used for decarburization.

Most of the electric furnace steel is poured into molds of the following sizes: 23 x 46 in., 21⅞ x 43 in., 22½ x 35 in., 22 ¾ x 52 in. and 21¾ x 21¾ in.

The electric furnaces are located in a new building composed of several bays. The stockyard is 200 ft x 87 ft-4 in., and is served by a 20-ton crane. The charging bay is 400 ft x 88 ft-6 in. and contains a 150/25-ton overhead crane. The pouring pit, 326 ft x 68 ft-8 in., has one 250/50/15-ton ladle crane.

The building is laid out to permit the use of hot metal in the electric furnaces.

BLOOMING MILL

Ingots from the open hearth and electric furnaces are shifted to the stripper building, where the molds are removed. Two stripper cranes (150-ton and 200-ton) are installed here. Ingots are then ready for charging into the soaking pits.

The blooming mill is served by seven blocks of pits, with three holes per block. Four blocks are of reversing, regenerative design, with each hole 12 to 13 ft long, 6 ft-8 in. to 7 ft-2 in. wide and 8 to 9 ft deep. Three newer blocks are of one-way recuperative design, 26 ft long x 8 ft-6 in. wide x 13 ft deep. These pits have two-stage ceramic tile and metallic recuperators.

Each of the four small blocks has a 1000-cfm, 4½-in. forced draft fan. One block is equipped with automatic combustion control, three are manually controlled.

On the larger pits, one-third of the combustion air is supplied by 5375-cfm, 3½-psi blower. This air passes through the metallic recuperator and then actuates a jet pump which draws the remaining two-thirds of required combustion air through the ceramic tile recuperator. Air is preheated to about 1000 F and flows to venturi type burners. All three of the larger pits are equipped with automatic combustion control.

All pits are fired with natural gas or coke oven gas. Ingots are charged to the pits at temperatures averaging about 1400 F. Heating time averages about 5.5 hr, ranging from 2 hr for very hot steel to as much as 10 hr for cold steel.

When ready for rolling, ingots are drawn from the pits by overhead cranes and conveyed to the mill table by a self-propelled motor-driven ingot buggy. Two pit cranes are provided, one rated at 20 tons and one at 7½ tons.

The blooming mill is a two-high reversing unit driven by a 7000-hp, 50/120 rpm, 700-volt d-c motor rated at 2,200,000 ft-lb at 47 rpm.

The mill uses cast steel rolls of 15 ft-7 ⅝ in. over-all length. The roll bodies are 37 in. in diam. and 92 in. long. Rolls carry passes of 8¾, 5¾ and 5⅜ in., a diagonal pass of 5 1/16 in. and a 54-in. bullhead. Each roll is driven through a 17½-in. spindle, and runs in composition roll-neck bearings.

Pinions are of cast alloy steel, of 48-in. pitch diam and 56-in. face. They are cut with 30-degree double helical teeth, 25-degree involute, with ½-in. diametral pitch.

Rolls are moved vertically at speeds up to 15 fpm by mill screws, 14 in. in diam, with 2-in. pitch. The screws

The blooming mill rolls ingots into billets 3⅞ to 6 in. square or slabs 3 to 6 in. thick and up to 50 in. wide.

are driven by two 100-hp, d-c mill-type motors. The top roll is hydraulically balanced.

Housing posts of the mill are 17 in. x 30½ in.

Power for the main drive motor is supplied by a motor-generator set consisting of two 3000-kw, 700-volt d-c generators, a 140,000-lb steel plate flywheel 15 ft in diam, and a 5000-hp, 6900-volt, 352-rpm induction motor.

On each side of the mill is a rack-and-pinion type manipulator driven by two 100-hp, d-c mill type motors. Lifting fingers on the entry side manipulator are driven by a similar 100-hp motor.

Approach tables are 51 ft-9 in. long, with 14 in. x 4-ft rollers on 27-in. centers. They are driven in two sections by two 50-hp motors. The front mill table is 43 ft-10 in. long and is composed of 18 in. x 8 ft-6 in. rollers on 27-in. centers. It is driven by two 100-hp motors. The back mill table is of similar construction but is 55 ft-1 in. long.

Mill scale falls through the tables and is washed by water to a scale pit. The pit is cleaned out by calm shell bucket on an overhead crane.

The runout table, composed of 14 in. x 4 ft-6 in. rollers on 4-ft centers, proceeds to the blooming mill shear, which is located 188 ft-4 in. from the mill. This table is driven in two sections by two 50-hp motors.

The shear is a down-cut unit, designed to cut material up to 6½ in. thick x 50 in. wide. It is driven by a 150-hp, 220-volt, wound-rotor motor which runs continuously, while the shear operates only when actuated through a motor-operated clutch. Crop ends from the shear drop into a pit and are carried up and out to a scrap car by a crop conveyor.

Roller tables proceed from the shear to two sets of slab pushers which move slabs from the table on to pilers. Spreader hooks on an overhead crane convey slabs from the pilers to the slab yard, where slabs are conditioned by manual scarfing.

Product from the blooming mill is moved into large storage bays running at right angles to the mill line. The other rolling mills are so located that their heating furnaces are adjacent to this storage, thus reducing handling and giving a smooth material flow through the plant.

The blooming mill receives ingots ranging from 21⅞ in. square (7437 lb) to 22¾ x 52 in. (22,850 lb). It reduces the ingots to billets from 3⅞ in. square to 6 in. square, or to slabs 3 in. to 6½ in. thick and up to 50 in. wide.

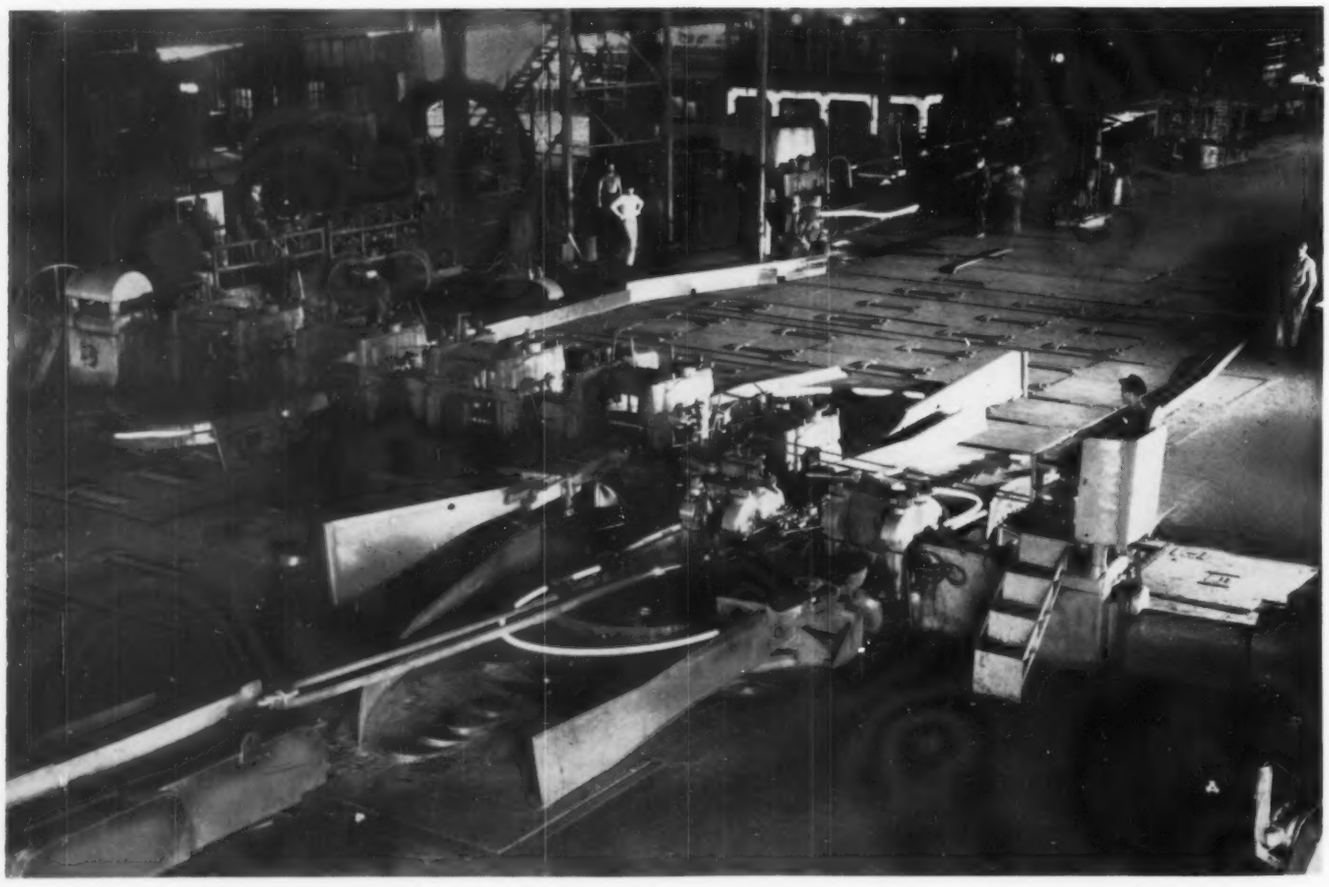
Approximately 60 per cent of the mill product is slabs, the remainder billets. Typical reductions are 19 passes for slabs, 21 passes for 4-in. square billets.

The blooming mill uses an average of 22 kwhr per ton of product for the main drive, plus 3 kwhr for the auxiliaries.

BAR MILL

Billets for the bar mill are moved by overhead cranes from the billet storage area to the heating furnace skids. There are two continuous furnaces with hearths 47 ft long x 10 ft wide. They are fired with

The bar mill reduces billets into rounds, squares, flats and light structural sections. This view shows finishing stands in the foreground, with heating furnaces at upper right, roughing stand at upper center.



natural gas, coke oven gas or fuel oil, and are equipped with temperature control, gas-air ratio control and furnace pressure control. There is no regeneration or recuperation.

The mill is a Belgian type layout. Heated billets from the furnaces are brought to an 18-in. three-high roughing stand, driven by an 800-hp, 2300-volt, 93-rpm, 25-cycle induction motor. After several roughing passes in this stand, the billet passes on to finishing stands over mill tables in which is located an up-cut shear to divide the billet. Steel is repeated by hand on the delivery side of all odd-numbered roughing passes. Sloping bar side guard type repeaters are used on the delivery side of even-numbered passes.

The finishing stands are located in two groups, the first consisting of five 12-in. stands, side by side, the second of two 9-in. stands. Four of the 12-in. stands and one 9-in. stand are three-high, the remainder are two-high. The 12-in. stands are driven directly by a single 900 to 1300-hp, 140 to 210-rpm, 2300-volt, 25-cycle induction motor operating under a Scherbius control system. A 400 to 600-hp, 2300-volt, 210 to 375-rpm, 25-cycle motor, also under Scherbius control, drives the two 9-in. stands. Bar mill drives operate on 25-cycle power supplied by a synchronous converter.

Composition bearings are used on all roll necks in the bar mill.

In the 12-in. stands, large bars, flats and angles are moved from stand to stand by table rolls and chain type drags, all at floor level. For small sections, repeaters are located between No. 1 delivery and No. 2 entry, No. 2 delivery and No. 3 entry, No. 3 delivery and No. 4 entry, and No. 4 delivery and No. 5 entry. They are curved, covered troughs of cast iron, fitted with bell-mouthed entry and guide box entry tongues.

A similar repeater is located between the two 9-in. stands.

The bar mill takes billets from $3\frac{3}{4}$ in. squares to 6 in. x 5 in., ranging 37 in. to 110 in. in length, and 138 lb to 900 lb in weight. It turns out rounds $\frac{7}{16}$ in. to $2\frac{1}{2}$ in. in diameter, squares from $\frac{7}{16}$ in. to $2\frac{1}{2}$ in., flats and strip from $\frac{3}{16}$ in. to 1 in. thick and $\frac{3}{4}$ in. to 6 in. wide, and small structural and special sections. The mill has rolled as much as 15,394 tons in one month. It uses 52 kwhr per ton on the main drives, plus 17 kwhr for auxiliaries.

Steel may be finished from the fifth 12-in. stand or the second 9-in. stand. From both of these stands the product proceeds through runout troughs to a rocker-type double cooling bed, 200 ft long. At the lower side of both beds are cold runout tables leading to the bar shears.

ROD MILL

Originally installed in 1910 and electrified in the late 20's, the Gadsden rod mill turns out tonnages comparable to that of modern units. The mill reduces $3\frac{7}{8}$ in.-square billets 70 to 78 in. long (298 to 332 lb) to rods $\frac{7}{32}$ to $\frac{11}{16}$ in. in diam. No. 5 rod is the principal product, and is rolled on a schedule typified by Table III. Square-oval passes are used.

The rod mill is served by four continuous end-charge, end-discharge heating furnaces. They are top-fired with natural gas, coke oven gas or oil, and have hearths 37 ft-8 in. long x 8 ft-3 in. wide. Automatic gas-air ratio control is provided. Combustion air is not preheated.

TABLE III
Rod Mill Data

Stand no.	Roll diameter, in.	Roll, rpm	Area of section, sq in.	Per cent reduction of area	Approximate speed, fpm
Initial	...	...	14.56	...	...
1	15–$17\frac{1}{4}$	27.71	10.23	29.7	108
2	15–17	27.91	6.81	33.5	109
3	14–$15\frac{1}{2}$	24.83	3.25	52.2	97
4	$14\frac{1}{2}$–$16\frac{1}{2}$	37.122	1.98	39.1	155
5	$14\frac{1}{2}$–$16\frac{1}{2}$	63.85	1.02	48.4	267
6	$16\frac{1}{2}$–$18\frac{1}{4}$	87.498	0.854	16.3	402
7	$15\frac{1}{4}$–$16\frac{1}{2}$	84.21	0.516	39.6	355
8	$11\frac{3}{8}$–$12\frac{3}{8}$	180	0.330	36.0	565
9	$12\frac{3}{4}$–$13\frac{15}{16}$	180	0.224	32.2	620
10	$12\frac{27}{32}$–$13\frac{21}{32}$	180	0.178	20.5	635
11	$10\frac{5}{8}$–$11\frac{21}{32}$	257	0.129	27.5	760
12	$11\frac{7}{8}$–$12\frac{3}{4}$	257	0.099	23.3	830
13	$10\frac{5}{8}$–$11\frac{21}{32}$	327	0.088	11.1	965
14	$11\frac{7}{8}$–$12\frac{3}{4}$	327	0.0698	20.6	1050
15	$10\frac{5}{8}$–$11\frac{21}{32}$	424	0.0583	16.5	1245
16	$11\frac{7}{8}$–$12\frac{7}{8}$	424	0.0457	21.6	1370
17	$10\frac{5}{8}$–$11\frac{21}{32}$	520/575	0.0421	7.9	1560/1730
18	$11\frac{3}{4}$–$12\frac{3}{4}$	520/575	0.0336	20.2	1700/1880

Billets are moved through the furnaces through the action of hydraulic rams at the charging ends of the furnaces.

The heated billets leaving the furnace move over a roller table to a continuous tandem roughing train consisting of seven 16-in. stands. The first six stands are driven through a gear set, line shaft and bevel gearing by a single 1750-hp, 514-rpm synchronous motor. The seventh stand is driven through a gear set coupled to a motor-generator set which supplies power to finishing stands No. 17 and 18. This motor-generator set consists of a 1000-kw, 250-volt, d-c generator driven by a 2100-hp, 720-rpm synchronous motor.

From the roughing train, the mill follows the Garrett layout. No. 8, 9 and 10 stands are 12-in. stands, side by side, driven by a direct-connected, 1750-hp, 180-rpm synchronous motor. A 1300-hp, 257-rpm synchronous motor drives No. 11 and 12 stands, which are 10-in. stands, side by side.

A 2750-hp, 450-rpm synchronous motor drives stands No. 13, 14, 15 and 16 through a gear set and dual spindles. These are 10-in. stands.

The finishing stands, No. 17 and 18, are 10-in. units, side by side, driven by a 1200-hp, 520 to 575-rpm, d-c motor which receives power from the previously mentioned motor-generator set. This use of an adjustable speed drive permits compensation for roll wear in these stands.

The synchronous motors were designed for 6900-volt, three-phase, 60-cycle, with 230-volt fields designed for 90 per cent leading power factor at full load.

The mill consumes 98 kwhr for the main drives and 8 kwhr for auxiliaries.

After the roughing train, repeaters are installed between the delivery sides of all even-numbered passes and the entry side of the odd-numbered passes. Between No. 8 and No. 9 stands is a four-way loop open trough. Between No. 10 and No. 11 is a six-way loop open trough. Seven-way loop open troughs are used between No. 12 and 13, No. 14 and 15, and No. 16 and 17. Manual catching and looping is performed between the

In the rod mill, billets 3⅞ in. square are rolled into No. 5 rod at a rate of 45 tons per hr, excellent performance for a mill of its design.

deliveries of odd-numbered passes and the entries of even-numbered passes.

All roll necks run in water-lubricated composition bearings.

Flow of material through the mill is rapid and continuous. The roughing train is set up for four rolling lines and the finishers are set up for seven lines.

Leaving the mill, rods are coiled on seven pouring reels which are driven through gearing by a 75–150 hp, 23-volt, 350–900-rpm d-c motor. Coils are then dropped on to a conveyor leading to a transfer track connecting the rod and wire mills. With low carbon steel, water is sprayed on the coils as they travel over the conveyor.

WIRE MILL

The wire mill contains facilities for manufacturing a wide range of wire and wire products. Coiled rod coming from the rod mill may be put into storage or directly into the production schedule.

The first step in the process is pickling and lime coating, which is done in a modern straight line unit.

The wire drawing department consists of 34 continuous drawing machines which are capable of drawing wire ranging in size from No. 22 gage to ½ in. diam.

Wire coils may be annealed in eight gas-fired pot furnaces.

Nails and staples are produced in 175 nail machines and five staple machines with a monthly capacity of almost 7500 tons. Almost any type and size of nail can be made, from ⅜ in. x No. 22 brads to 12 x ⅜ in.

Three continuous 36-strand hot dip galvanizing lines can process wire running from No. 2 gage to No. 22 gage.

There are 12 machines capable of weaving the various types of field fencing of No. 11 to No. 18 gage wire. There are also 64 machines that can turn out various types of barbed wire.

Capacity for bale ties is provided by 12 machines that can produce ties of 16½ to 12 gage, 3 ft to 14 ft long. Four baling wire machines will make the two standard automatic baling wire coils from No. 14½ gage annealed wire.

Ten straighten-and-cut machines provide 1800 tons per month capacity for cut lengths of rod 7/32 to 7/16 in. in diameter and wire from No. 16 gage to ⅜ in.

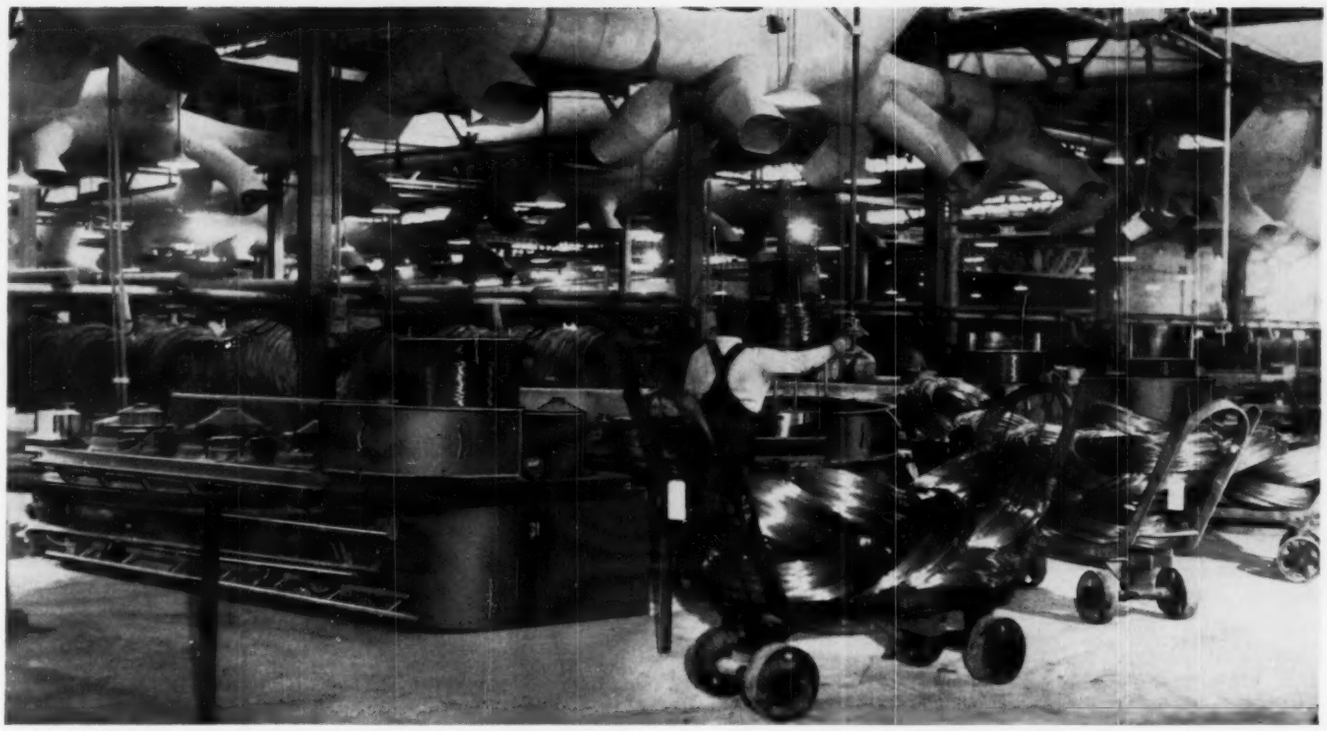
WIRE MESH PLANT

The wire mesh plant has two machines, one for the production of heavy mesh up to 6 ft wide, as used for sewer pipe manufacture, the other for a lighter mesh up to 9 ft-6 in. wide, as used in road and building construction. Another machine to make mesh up to 13 ft wide is to be installed. This department also fabricates bar steel joists up to 100 ft in length.

Another fabricating department in this plant bends concrete reinforcing bar to suit customer requirements.

BOLT AND NUT DEPARTMENT

Bolts, nuts, rivets, etc., are produced in a shop equipped to make a broad variety of these items. Ten cold headers, five trimmers and eight roll threading machines turn out rolled or cut thread machine or carriage bolts ¼ in. to ½ in. in diam x 6 in. long, and all types of rivets in this size range. Another cold header

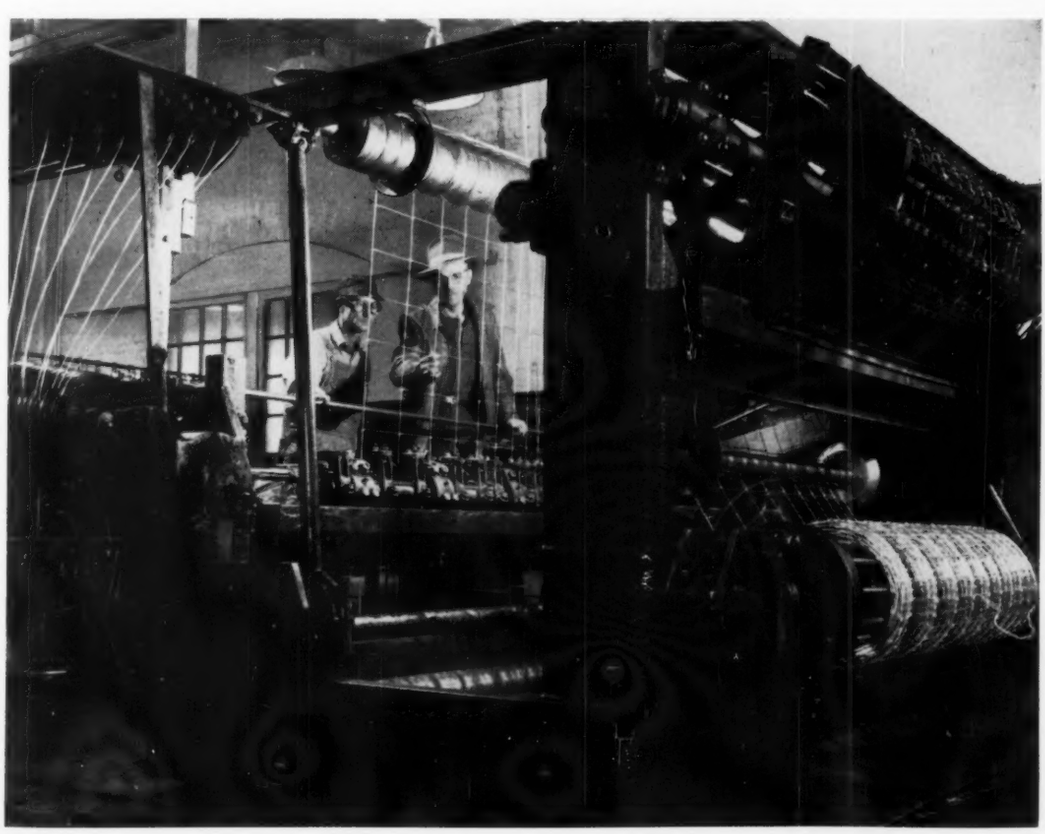


Wire drawing is performed by 34 continuous machines, turning out wire from No. 22 gage to ½ in. diam.

produces 3/16-and ¼-in. rivets up to 1 in. long. A nut tapper processes square and hexagon nuts, 5/8 in. through 1¼ in.

Two continuous hot header machines, two trimmers and eight automatic threaders make square and hexagon head machine bolts, carriage bolts and all types of rivets 5/8 through 1 in. in diam up to 6 in. long. Two hand tong headers are used for bolts 5/8 through 1 in. in diam in lengths of 6½ in. or more. One 1½-in. header is used for heading machine and carriage bolts and rivets, 1⅛ through 1½ in. diam, any length. Two hammer header machines take care of bolts ½ in. or less x 6½ in. or more.

There are also three four-spindle semi-automatic hand threader machines, one three-spindle hand threader, one two-spindle hand threader, five pointing machines and



Twelve wire fence machines produce 2200 tons per month of the various types and weights of field fencing.

an upright roll threader machine, as well as shears for cutting stock for header machines, and a shear and punch press for processing plates used with mine roof bolts.

PLATE MILL

The Gadsden plant has been in the plate business for many years with a sheared and universal plate mill. Since the large diameter pipe mill was installed at this plant in 1948, virtually the entire output of the plate mill has gone into the production of 24-in., 26-in. and 30-in. gas transmission pipe. This unit has recently inherited the additional job of acting as the rougher for a hot strip mill.

Slabs for the plate mill are heated in two continuous end-charge, end-discharge furnaces of 86 ft-9¾ in. overall length, with hearths 80 ft long x 19 ft wide. Rated at 100 tons per hr each, the furnaces are of triple-zone design, and fired with natural gas, coke oven gas or fuel oil. Six long-flame combination burners overfire the main heating zone and six more underfire it. The soaking zone, 17 ft long, is overfired by eight similar burners. The 20 burners provide a total maximum input of 185,000,000 Btu per hr.

The furnaces have flat suspended arch roofs and are completely insulated and steel encased. Roof insulation consists of 2½-in. blocks. Sidewalls have 4½ in. of high temperature insulation covered by 1-in. blocks, while 5 in. of blocks insulate the bottom of the hearth.

Each zone of each furnace is equipped with one fuel-air ratio control and two fuel input controls, one for oil and one for gas. Each furnace also has a furnace pressure control. Automatic temperature control is applied to the top heating zones and, through relay control, to the bottom zones as well. In the soaking zones, temperature is also controlled automatically, using a radiation pickup. Indicating and recording instruments are provided on these temperatures, as well as on fuel and air flow, fuel pressures and recuperator temperatures.

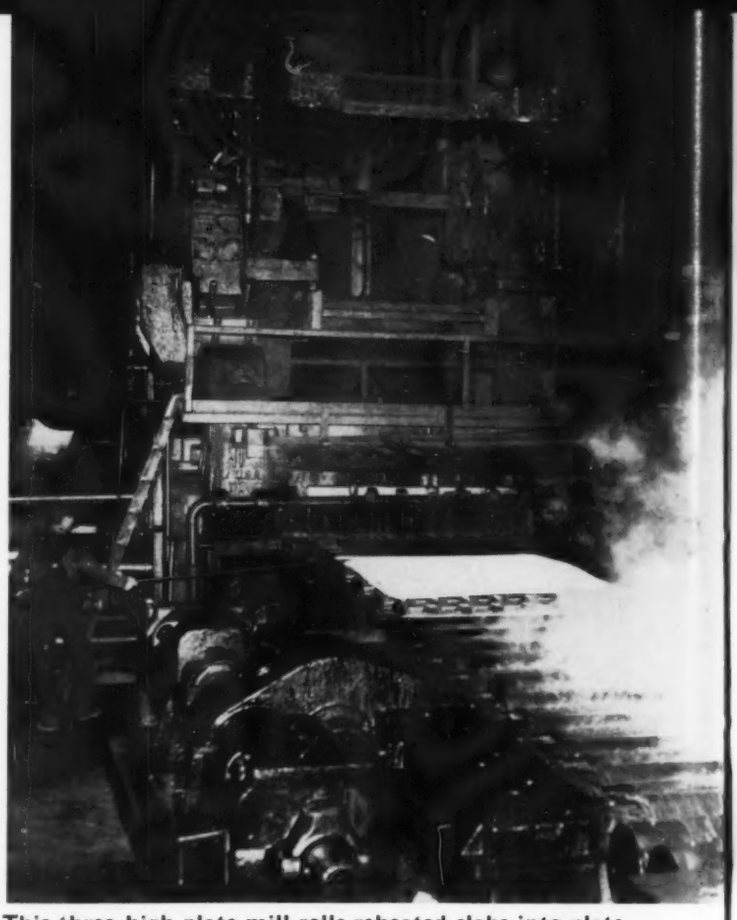
Combustion air is preheated by two metallic recuperators on each furnace. Waste gas comes to the recuperators at about 1750 F. A 48,800-cfm, 8-in. water column fan supplies air to each furnace.

All slabs are cold when charged to these heating furnaces. Fuel consumption averages 2,374,000 Btu per ton of slabs heated.

Slabs are brought from the slab yard by overhead crane to the magazine elevator depiler of each furnace, and pushed off the depiler on the furnace skids. The double arm pusher of each furnace may work as a unit on long slabs, or may be sectionalized for two rows of short slabs. Each elevator has 12½-in. cylinder of 3 ft-11 in. stroke, operated by 600-psi hydraulic oil pressure. Two 50-hp motors operate each pusher.

As a heated slab is discharged from the furnace through the action of the pusher, it slides onto a roller table and is conveyed to a two-high scalebreaker and then to the three-high 112-in. plate mill. Details of both of these stands and their drives are given in Table IV. A tilting table 29 ft-6 in. long on each side of the plate mill, driven by two 85-hp d-c mill type motors, handles the steel as it is rolled back and forth.

The horizontal rolls, which are balanced hydraulically, are adjusted by 10-in., 1¼-in. pitch mill screws,



This three-high plate mill rolls reheated slabs into plate, into skelp for the pipe mill, or into breakdowns to be finished in the strip mill.

driven by a 60-hp, d-c mill motor. Maximum roll lift is 10 in. The middle roll is shifted by hydraulic cylinder. Roll necks operate in water-lubricated composition bearings.

Four vertical rolls, 24½ in. in diam x 25 in. long, are located in the universal stand, two ahead of the horizontal rolls, two in back. They operate in bronze bushings and are driven through bevel gearing by the main drive motor, which generates a maximum operating torque of 720,000 ft-lb.

The vertical rolls are used only when the mill is rolling breakdowns for the hot strip mill. No universal plate is produced. Maximum opening between the vertical rolls is 69½ in.

Power for the main drive motor comes from a motor-generator set composed of two 1600-kw, 800-volt, d-c generators, a 64,000-lb steel plate flywheel 120 in. in diam, and a 4000-hp, 6900-volt, 712-rpm induction motor.

Descaling sprays, using water at 1200-psi pressure, are located in front and back of the scalebreaker and the mill.

The plate mill receives slabs 30 to 49 in. wide, 3½ to 8 in. thick, and up to 204 in. long. For strip breakdowns, slabs are usually 3½ in. thick x 204 in. long. The mill produces plate ranging from 54 to 92 in. wide and ¼ to ½ in. thick. Breakdowns for the strip mill may range from ½ in. thick (for 0.08-in. product) to ⅞ or 1 in. thick for 0.25-in. product. Average production on plate is 49.4 tons per hr; on breakdowns an average rate of 125 tons per hr is par.

Plate rolled on the 112-in. mill proceeds over the

TABLE IV
Strip Mill Data

Stand	Roll diameter, in.		Roll body length, in.	Distance from preceding stand, ft-in.	Motor data				Gear ratio	Roll, rpm	Roll face speed, fpm
	Work roll	Backup roll			Hp	Voltage	Type	Rpm			
Hot Mill											
Scalebreaker	26½	...	56	...	800	2300	a-c	354	12.2	29	200
3-high rougher	24	34½	114	95-9½	4000	800	d-c	80/160	...	80/160	720/440
4-high finisher	25	53	54	257-2	3500	700	d-c	150/336	3.17	47.3/106	310/695
4-high finisher	25	53	54	18-0	3500	700	d-c	150/300	1.90	79/158	518/1036
4-high finisher	25	53	54	18-0	3500	700	d-c	110/220	Direct	110/220	720/1440
4-high finisher	25	53	54	18-0	3500	700	d-c	135/270	Direct	135/270	885/1770
Cold mills											
Tandem cold mill											
No. 1 stand	21	53	54	...	3500	600	d-c	90/225	Direct	90/225	495/1237
No. 2 stand	21	53	54	13-6	3500	600	d-c	135/305	Direct	135/305	742/1677
No. 3 stand	21	53	54	13-6	3500	600	d-c	175/375	Direct	175/375	962/2062
Reel					1000	600	d-c	100/430			
Temper mill	21	53	54	...	1000	600	d-c	275/550	Direct	275/550	1512/3024
Reel					1200	600	d-c	320/1050			
2-high cold mill	26	...	64	...	400	2300	a-c	350	16⅔	21	143
3-high jobbing mill	17	30	72	...	1500	6900	a-c	594	20.6	23.4	184

runout table and is moved on to a link-and-chain cooling bed transfer, about 67 ft x 48 ft, then over a conveyor, through a roller leveler, end shear and rotary side shear, and on to plate racks.

Breakdowns leave the plate mill and proceed over a roller table about 250 ft long to the strip finishing train.

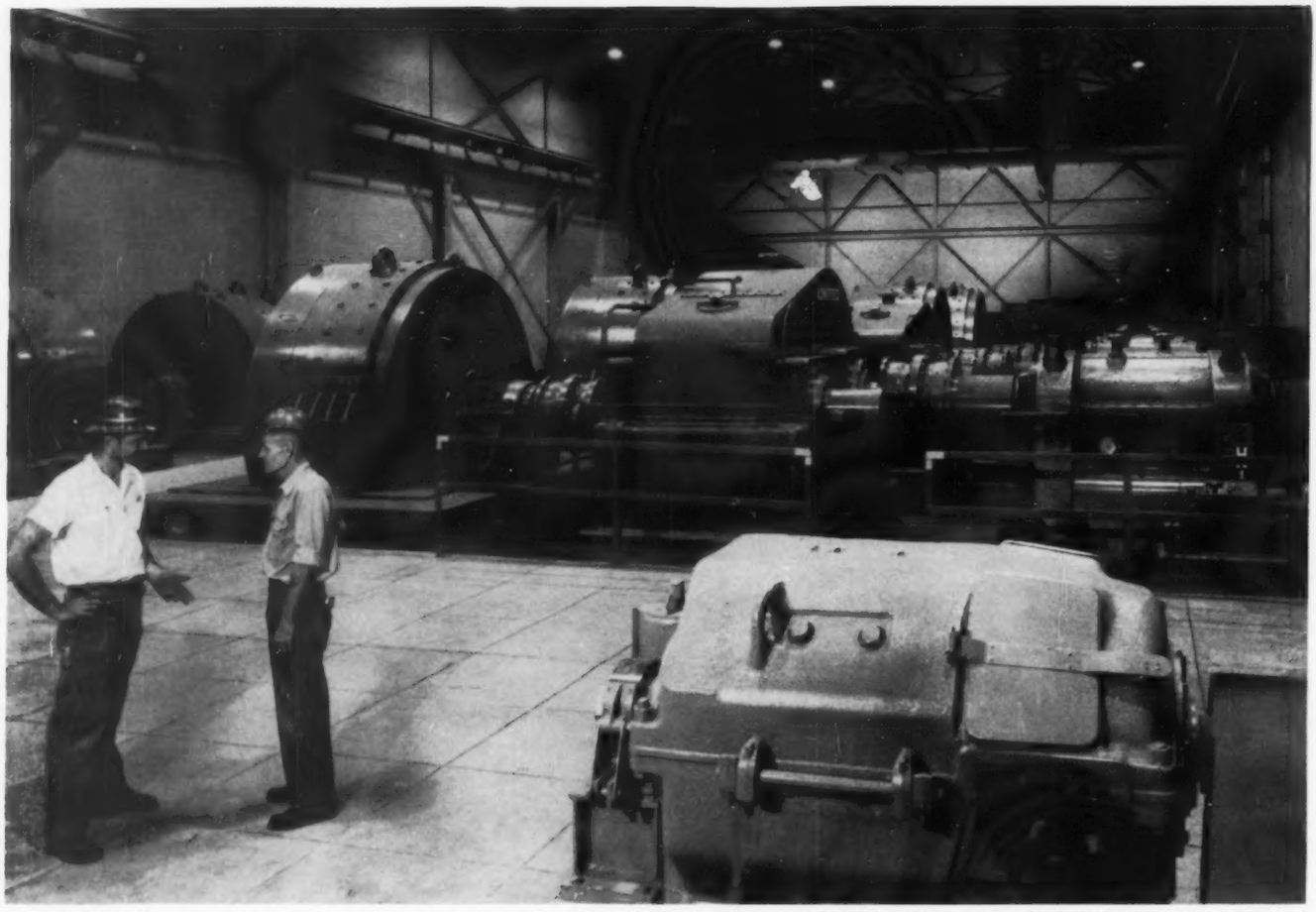
STRIP MILL

The strip mill is a recent addition to the Gadsden plant, putting flat rolling facilities in step with modern practice. Some details of this mill are given in Table IV.

The finishing train is spaced some 250 ft from the universal mill. A drum-type flying crop shear is provided about 30 ft ahead of the finishers to square up the end of the breakdown. Designed to cut hot steel up to 1 in. thick and 49 in. wide at speeds of 100 to 400 fpm, it is driven by a 200/400-hp, 420/840-rpm, d-c motor.

The cast steel mill housings are of closed top design, tied together top and bottom by cast steel separators. Housing posts each provide 870-sq in. cross-sectional area. The housing windows are 55 in. wide inside the steel liners. Each stand is provided with entry and delivery guides, with air-operated hold-downs on the last two stands.

The strip finishing train consists of four 4-high, 21 in. and 53 in. x 54 in. stands which deliver strip at speeds up to 1770 fpm.



The strip mill motor room, which contains main drives, gear sets, pinions, control equipment and switchgear, is ventilated by forced air recirculation.

Between the finishing stands are loopers, operated by 50-hp torque motors rated at 236 ft-lb, to take up slack in the strip between successive stands.

Work rolls are of alloyed iron and run in roller bearings. Backup rolls, of cast steel, operate in oil-film bearings. Rolls are adjusted by two 50-hp, 550/1650-rpm, d-c mill motors on each stand, connected by magnetic clutch. Gearing on the screw-down drives gives over-all ratios of 516.5:1 on the first three stands, and 1025:1 on the fourth stand. Since the mill screw leads are 0.4 in., roll movement is 0.424/1.272 in. per min on the first three stands, and 0.214/0.643 in. per min on the fourth stand. Selsyn indicators show the roll openings.

The top rolls are hydraulically balanced, through a yoke, hanger bars and corner beams, by a cylinder mounted in the top housing separator. Top work rolls are balanced by cylinders in the chocks.

To insure good strip surface, double descaling sprays are provided, top and bottom, at the finishing scale-breaker. Water is supplied to these sprays by two 1200-gpm, 1200-psi centrifugal pumps, each driven through step-up gears by a 1250-hp, 1750-rpm motor. The water used for descaling is put through a 1200-gpm filter.

An x-ray gage at the exit of the last finishing stand provides an indication of strip thickness.

Leaving the finishing train, strip passes over a runout table, about 324 ft long, to a paddle-type reel designed to coil strip up to 48 in. wide. Coils are formed 24 in. inside diameter and up to 50 in. outside diameter, with a maximum weight of 15,000 lb. The coiler is driven by a 150-hp, 460/920-rpm, d-c motor through a gear reduction of 2.56 to 1 ratio, enabling the unit to handle strip at speeds up to 2260 fpm.

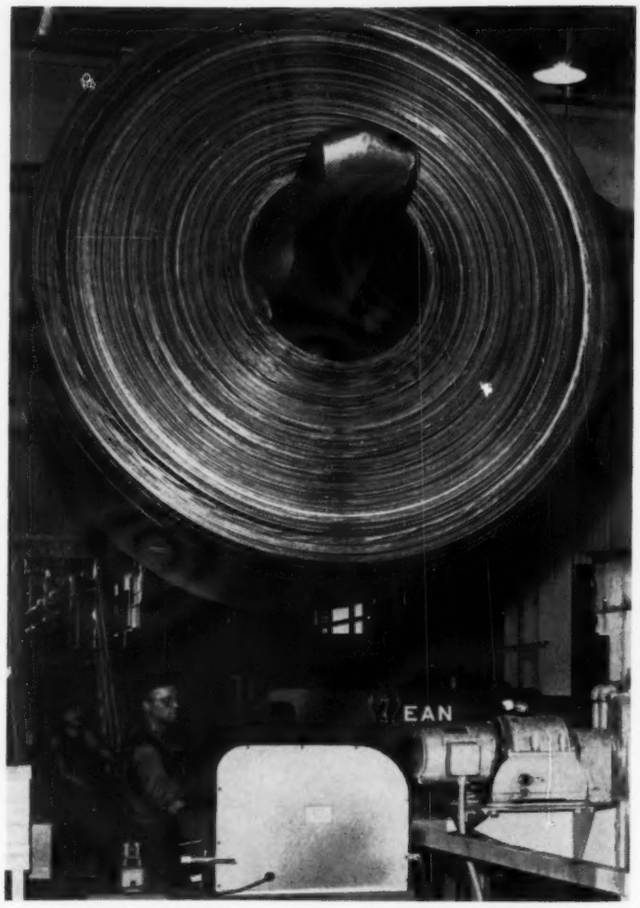
The runout table between finishing train and coiler consists of 163 cast iron rollers, 10 in. in diam x 54 in. body length, on 2-ft centers, individually driven by a 3-hp, 0/750/975-rpm, d-c motor, giving table speeds up to 2550 fpm. About half of the runout table length is covered with water sprays to control coiling temperature.

All main drive motors, gear sets, pinion sets, control equipment and switchgear for the finishing train are located in a motor room, 250 ft long x 80 ft wide, located beside the mill building.

The four finishing stand motors, operating on adjustable voltage control, receive power from two motor-generator sets, each consisting of two 2800-kw, 700-volt, d-c generators and an 8000-hp, 13,800-volt, 3600-rpm motor. This d-c system is sectionalized so that each motor is served by an individual generator.

The motor room is ventilated by forced air recirculation, with down-draft through the rotating machines. The air is then cooled by surface coolers. Make-up air to the system is cleaned by filtering.

The strip mill is lubricated by four centralized pressure grease systems and two circulating oil systems. A grease system serves each of the following applications: (1) finishing scale breaker and four finishing stands; (2) chutes and loopers on finishing train; (3) crop shear approach table, side guards, shear and mill approach table; and (4) runout table, sideguards and coiler.



In the continuous strip pickler, coils are built up to a maximum of 72 in. outside diameter and 40,000-lb weight.

Other points requiring grease lubrication are provided with fittings for manual lubrication.

One oil system, with a capacity of 142 gpm of 2400/2500-SSU oil at 100 F, serves the backup roll neck bearings of the finishing stands. Another oil system, rated at 300–gpm of 2000-SSU oil at 100 F serves the gear sets of the first two finishing stands, the pinion stands, screw-down mechanisms.

The finishing train is laid out so that two more stands, one ahead and one behind the present four stands, may be installed if it becomes desirable.

Coils are removed from the hot mill coiler by a stripper plate driven through pinion and rack by a 35-hp motor. A down-tilter receives the coil and deposits it onto a chain conveyor about 100 ft long, operating at 21 fpm. This conveyor moves the coils to a storage area, where they are handled by overhead crane.

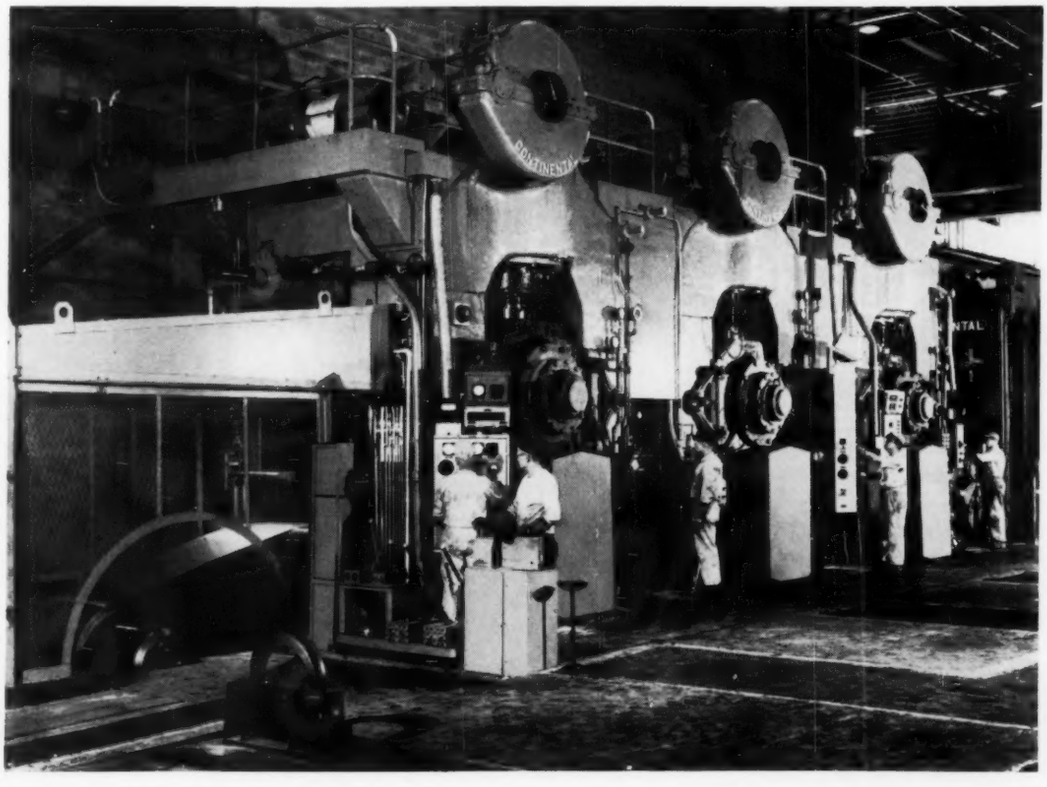
Some of these coils are sold as hot rolled product, to be used for oil drums, tanks, etc. The greater part, however, goes into cold finished product.

Hot finishing facilities include a shearing line that will take 15,000-lb coils from the hot mill and cut them into lengths of 3 to 16 ft. It will handle material up to 48 in. wide and up to 0.25 in. thick at speeds up to 160 fpm. The line includes an uncoiler, side trimmer with scrap chopper, a hump table, pinch rolls, up-cut shear, gager head and table, and runout conveyor.

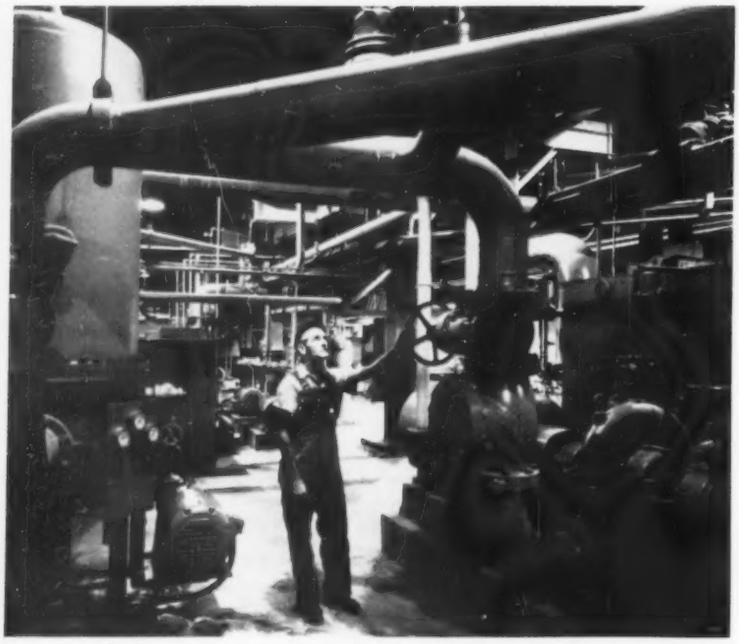
A stretcher leveler, resquaring shear, two two-high cold mills and a three-high jobbing hot mill are also provided.

COLD FINISHING

Coils to be cold reduced are placed by overhead crane on to a conveyor leading to a continuous pickling line 388 ft-5¼ in. long overall. The entry end of this line includes a processing uncoiler, an up-cut shear for trimming coil ends, a flash welder, weld trimmer, a looping pit and pinch rolls. A continuous strand of material is formed by butting the ends together and flash welding. The looping pit provides storage for enough length of strip to allow continuous travel through the pickling



This three-stand 21 in. and 53 in. x 54 in. cold mill rolls hot-rolled, pickled strip at speeds up to 2062 fpm.



Oil systems for the tandem cold mill are grouped in this cellar.

tanks during stops of the entry end for fastening the strips together.

The line contains a three-section acid tank of single unit design, followed by a waterspray rinse and a hot water tank. All tanks are constructed of welded steel plate, lined with ⅜ in. of rubber and a 12½-in. inner liner of acid-resisting brick. Each section of the acid tank is 56 ft-2 in. long x 5 ft-9 in. wide x 4 ft-1½ in. deep, and holds 7125 gal of sulphuric acid solution. This solution is heated by steam, with temperature automatically maintained at 200 F. Solutions are cascaded back from tank to tank toward the entry end.

The tanks have welded steel covers lined with rubber and vented to the atmosphere through rubber-lined ducts, fan and scrubber.

From the hot water tank, strip proceeds through a dryer, pinch rolls, a shear for separating the continuous strand of material, and a recoiler. Strip speed through the line ranges up to 300 fpm in the pickling tanks and exit end, with the entry end capable of speeds up to 750 fpm.

The pickler can take hot rolled stock 24 to 49 in. wide x 0.072 to 0.187 in. thick, in coils 24 in. inside diameter and 54 in. outside diameter, with a maximum weight of 15,000 lb. The exit coiler forms coils 24-in. inside diameter and up to 72-in. outside diameter, with a maximum weight of 40,000 lb.

Most of the pickled coils go to a 54-in. three-stand tandem cold reduction mill. Details of this mill are given in Table IV. Roller bearings are used on work roll necks, oil film bearings on backup necks. Mill screws on each stand are adjusted by two 50-hp, d-c mill motors.

Power for the cold mill drive motors comes from a motor-generator set consisting of three 2800-kw, 600-volt, d-c generators, one 800-kw, 600-volt, d-c generator and a 13,000-hp, 13,200-volt, 3600-rpm motor.

The tandem mill reduces strip 24 to 48 in. wide from 0.072 to 0.125 in. thickness down to thicknesses of 0.0239 to 0.1196 in. In widths of 24 to 36 in., finished gages may run down to 0.0149 to 0.0209 in. The mill is equipped with indicating devices showing roll pressures and strip tension. Automatic screw-down control is also provided on No. 1 and 3 stands to maintain gage accuracy on the cold-rolled product.

Gage reduction in cold rolling may run to as much as 80 per cent, causing the steel to become hard and stiff. To offset this, coils are annealed in 20 single-stack, radiant tube furnaces. These units are 72 in. in diam and permit a piling height of 162 in. They are fired with natural gas or coke oven gas, and are equipped with automatic temperature control. Three 15,000-cfhr deoxidizing gas machines provide atmospheres in the annealing covers. There are 50 bases installed for these covers. Annealing cycles run about 72 hr, of which one-third is heating time.

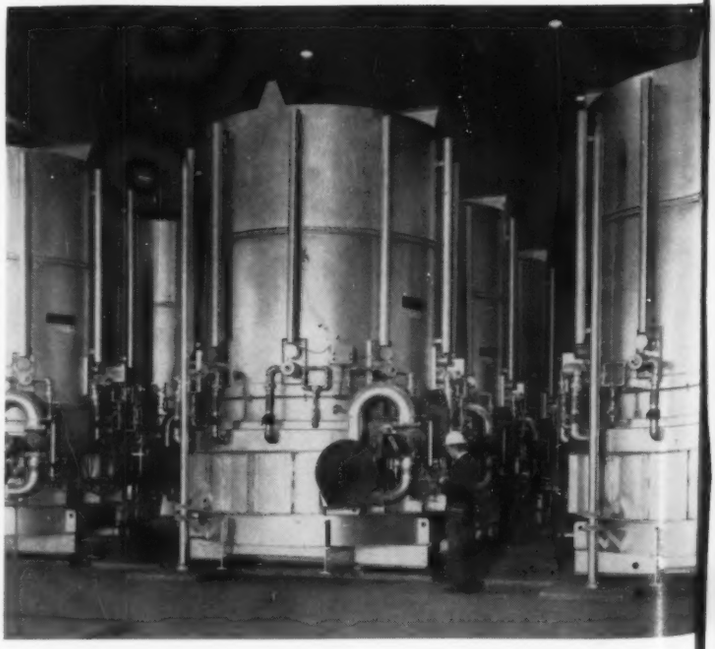
To impart good surface and modify physical characteristics of the annealed strip, it is next passed through a 54-in., four-high, single-stand temper mill, where it receives a reduction in gage of ½ to one per cent. This reduction may run as high as five per cent for certain special products. Details of this unit are given in Table IV. Roller bearings are used on the necks of both work and backup rolls.

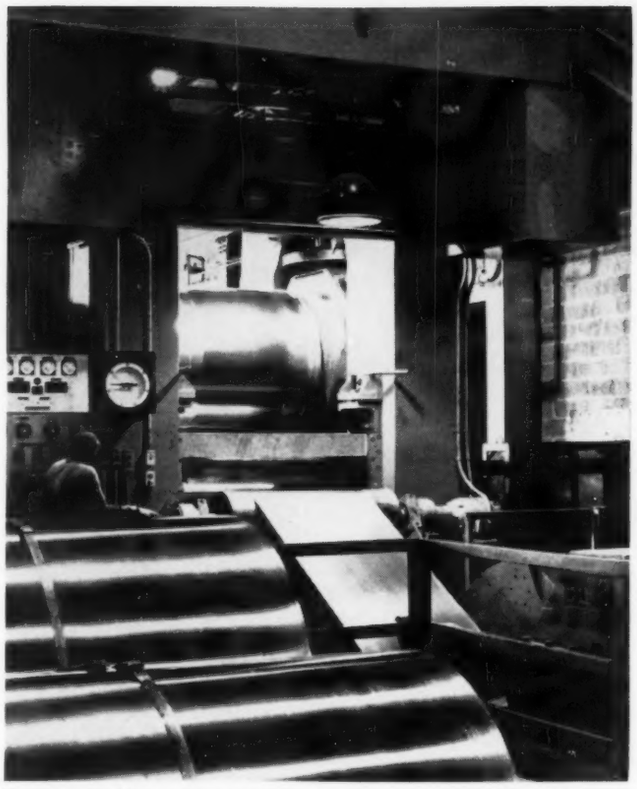
Power for the temper mill comes from a motor-generator set consisting of a 960-kw, 600-volt, d-c generator for the reel motor, an 800-kw, 600-volt, d-c generator for the main drive, and a 2250-hp, 6900-volt, 720-rpm motor. A drag generator rated at 300-kw, 250-volt, 320/1050-rpm on the pay-off reel provides back tension on this mill.

The cold finishing department also includes a slitting line which handles material up to 48 in. wide in gages of 0.015 to 0.134 in. at speeds up to 600 fpm; a cut-up line which cuts strip 18 to 48½-in. wide and 0.015 to 0.125 in. thick into lengths of 2 ft-6 in. to 20 ft at speeds up to 300 fpm; and a continuous galvanizing line.

The galvanizing line is a continuous hot-dip unit that handles widths of 24 to 48 in. at speeds up to 300 fpm. The unit contains uncoilers, end-cut shears, lap welder,

Twenty single-stack radiant tube covers are used to anneal cold-reduced coils.





Temper rolling improves strip surface and stiffens the annealed product to the desired degree.

side trimmer and scrap baller, looping pit, cleaning tanks, flux tank, preheat oven, spelter pot with coating rolls, cooling tower, roller leveler, chemical treating tanks, rinse tank and dryer, looping pit, coiler, shear, classifier and pilers.

The continuous hot-dip galvanizing line coats strip at speeds up to 300 fpm. Product may be coiled or cut to length.

The surface preparation section of the line includes an acid treatment, spray and dip rinsing, scrubbing, alkaline cleaning and flux coating. Flux is applied over the strip surface by an aqueous solution. The flux is dried and the strip preheated in a conduction oven through which the strip passes vertically.

Strip then enters an induction heated pot. Zinc ingots are melted in a pre-melt pot and the molten zinc flows to the galvanizing pot through a heated runway. The strip is immersed in the zinc bath by sink rolls. Coating thickness is regulated by the coating rolls. Leaving the zinc bath, the strip is cooled by air blasts.

The roller leveler, chemical treatment tank, hot water spray and dip tank, and dryer compose the finishing section.

The line is equipped for recoiling or shearing. The flying shear can cut to lengths of 3 to 14 ft. The classifier automatically shunts sheets with pinholes or gage variation to a reject section, while prime product proceeds to a hydraulic lift piler.

Some of the galvanized product is made into roofing and roofing accessories. The rest is sold to manufacturers and fabricators. Two barrel type corrugating machines and one roll machine turn out corrugated sheets of 16 to 30 gage, up to 36 in. wide and up to 12 ft long. Two ridge roll machines are also provided.

PIPE MILL

In 1948 Republic installed a mill for the production of fusion welded line pipe. This unit has been recently modernized to handle greater wall thicknesses and to increase production. It now takes plates (or skelp) 72 to 93 in. wide, 0.25 to 0.50 in. thick and 28 ft-6 in. to 31 ft-6 in. long from the plate mill and turns out line pipe of 24, 26, 28 or 30 in. outside diameter.

Plate is moved by magnet gantry crane, one piece at a time from a stack, flattened by roller leveler and put into an edge planer. Here cutting tools travel along both edges, bringing the plate to uniform, predetermined width, with parallel machined edges.

The plate is next cropped on both ends and conveyed to a shot blast unit which cleans top and bottom surfaces of the plate edges. An edge former next roll-forms the plate edges, imparting a curvature to provide the proper radius to the extreme edges.

Two presses complete formation of the pipe. A "U" press forms the plate into U-shape by the travel of a center die punch down through a 42-in. maximum stroke between two rows of universal rocker dies.

A second press finishes the forming in a single 43-in. stroke.

The formed cylinder is next conveyed to the entry end of one of the four welders. The longitudinal edges of each cylinder are matched and the ends tack welded for three or four inches on each side of the longitudinal seams. The strings of attached cylinders are moved by three driven rolls through welding cages containing two submerged arcs, one d-c, one a-c. These arcs weld the outside of the seam. The string of cylinders is then flame cut apart into separate lengths.

The pipe is next moved to the inside welders, of which there are four. Here the pipe is conveyed so that a cantilever boom carrying two welding heads passes through the pipe, welding the inside seam.

After internal cleaning, inspection and end con-

ditioning, the pipe is expanded hydraulically by introducing water at pressures up to 4200 psi. This exceeds the yield point of the pipe, expanding it about 1½ per cent. This operation rounds out and straightens the pipe, tests and stress-relieves the weld, and strengthens the pipe itself. There are two of these expanding machines.

Next, a 30-degree bevel is machined on each end of the pipe. The pipe is then given another inspection.

If 60-ft lengths are desired, two 30-ft lengths are lined up and girth-welded by submerged arc welding.

SERVICES

Electric power for the Gadsden plant is partially generated, partially purchased. The power plant is located near the blast furnaces. Steam is generated in five 907-hp bent-tube boilers and two 100,000-lb per hr radiant furnace units. They are designed for 400-psi pressure, 700 F total temperature. Blast furnace gas is the basic fuel on all boilers, with natural gas as an auxiliary. In addition, pulverized coal may be used on four of the bent-tube boilers.

Each bent-tube unit has 9078 sq ft of boiler heating surface and 7878 sq ft of plate type air-preheater surface. Each radiant furnace has 6200 sq ft of tubular heating surface and 11,300 sq ft of radiant surface.

Steam generated in these units is used for blast furnace blowers, for power generation and for process work and miscellaneous usage throughout the plant.

Power is generated by three 5000-kva, 385-psi pressure units, two of which exhaust into two 2500-kva low pressure turbogenerators. Surface condensers are installed on one 5000-kva machine and on both low pressure turbines. This combination uses 14.2 lb of steam per kwhr generated. Total generating capacity is therefore 20,000 kva, all at 6900 volt, 60 cycle. Generated power supplies the coke plant and blast furnace area and the main pump house, and is fed to the rod mill substation.

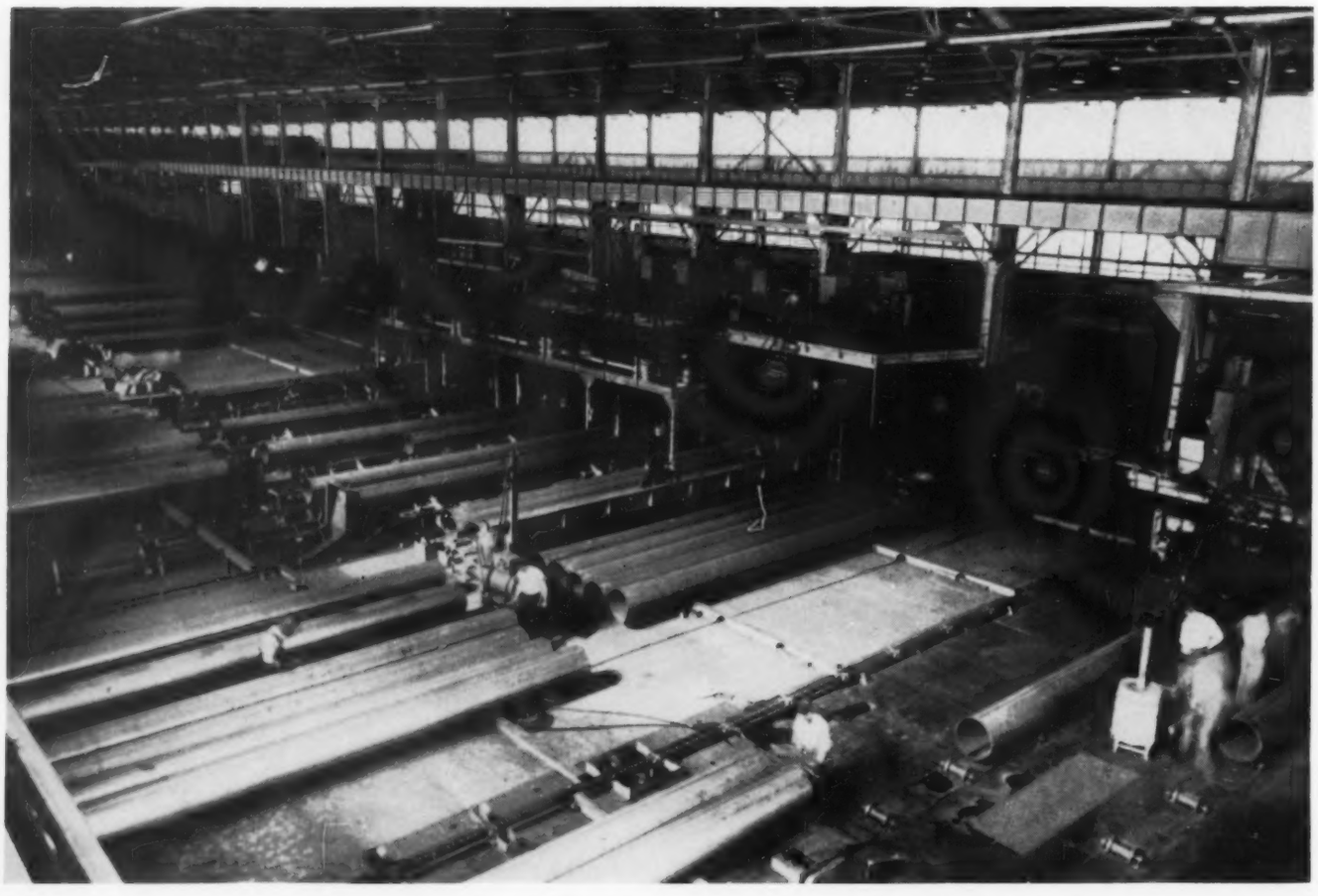
Purchased power comes to the utility's substation serving the plant at 110,000 volts, and is reduced to 13,800 volt by two 41,000-kva banks and two 20,000-kva banks of transformers. A 40,000-kva synchronous condenser is also installed here.

At 13,800 volt, purchased power is transmitted to two principal centers, the electric furnace department and the hot strip mill motor room. From the latter, power is distributed to substations at the cold reduction mill, the strip pickler and the temper mill, and to a substation at the rod mill. The rod mill station in turn sends power to the blooming mill and bar mill substations.

Power generation averages about 8,000,000 kwhr per month. Purchased power, exclusive of the electric furnace load, runs approximately 9,500,000 kwhr per month. When the electric furnaces operate fully, they may add another 18,000,000 to 20,000,000 kwhr to the monthly purchase.

Fuel for the entire plant is largely gaseous, made up of blast furnace gas, coke oven gas and natural gas, with some bunker C fuel oil. In a typical day of full

Installed in 1948, the fusion welded pipe mill produced line pipe of 24, 26, 28 and 30 in. outside diameter.



Physical testing equipment, as well as complete chemical laboratory facilities, insure product quality to meet customer requirements.

operations, the quantities are somewhat as follows:

Surplus blast furnace gas to boilers, 151,000,000 cu ft.

Surplus coke oven gas to soaking pits, plate mill and miscellaneous usage, 13,000,000 cu ft.

Natural gas to open hearth, plate mill, rod mill, bar mill, coil anneal boilers and miscellaneous, 20,000,000 cu ft.

Fuel oil to open hearth, 32,600 gal.

Steam coal to boilers (stand-by), 80 tons.

When the soaking pits and strip mill are down, surplus coke gas is used at the bar and rod mills, in the open hearth furnaces and at the coil anneal.

When the supply of natural gas tightens, its use in the open hearth, plate and strip mill, bar mill and rod mill is curtailed and fuel oil substituted.

Oil is barged up the Warrior River to Birmingport 85 miles west of Gadsden and brought to the plant in tank trucks. It is unloaded at any of three stations: the open hearth, where there is 350,000-gal storage capacity; the mill station, with 230,000-gal storage; or a stand-by storage of 400,000-gal storage.

Service water comes from the Coosa River, where there is a pump house containing three 20,000-gpm pumps, and from Wills Creek, where five pumps provide a total capacity of 40,500 gpm. Normally, about 58,000,000 gal per day come from the Coosa station and 10,000,000 from Wills Creek.

Water from the Coosa station follows three principal paths: through the air coolers at the strip mill motor room and into the general service system; through two surface condensers and into a reservoir; and to the coke plant. Water from the Wills Creek station also flows into the reservoir.

From this reservoir, water goes through three surface condensers and into a second reservoir. From both reservoirs, pumps with a total capacity of 45,500 gpm put water into the general service system.

For boiler feed makeup, water is clarified with ferric sulphate, put through gravity filters and finished up in zeolite softeners. This unit has a capacity of 450 gpm.

Water used for descaling and processing in the strip mill goes through a 6000-gpm clarifier where it is treated with aluminum sulphate. For some wire mill processes, water is put through a 1000-gpm coagulation and settling tank, where it is treated with aluminum sulphate and filtered.

A complete setup of service shops takes care of almost all maintenance work. An electrical repair shop handles all motor work except the very large units. Mechanical shops include machine, welding, forge, boiler and fabricating, car repair, locomotive, rigger, pipe, tractor repair, pattern, carpenter, lubrication, scale repair and a brass, steel and cast iron foundry.

A new roll shop was built recently to serve the strip mill. There are three roll grinders here, of 36-in., 44-in. and 50-in. size respectively. This shop, with the shops at the bar mill and the rod mill, comprise the roll department of the plant.

The shops are housed in separate buildings, grouped to a large extent in the central portion of the plant. They enable the Gadsden plant to be practically self-sufficient, maintenance-wise.

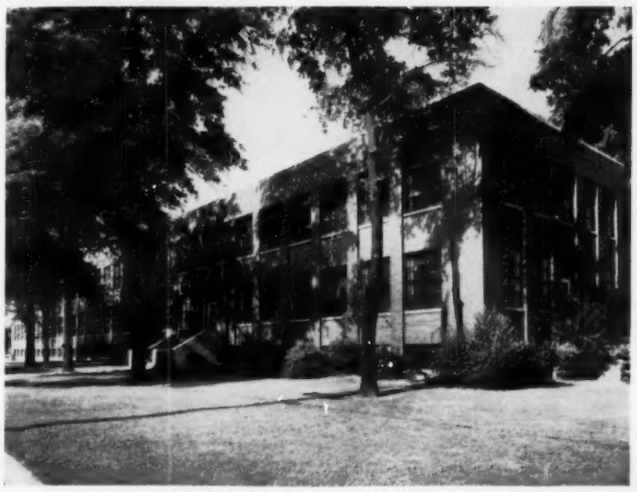
Transportation within the plant is principally over 42 miles of standard gage railroad track. Eight diesel-electric locomotives (80 to 125 tons), three 45-ton diesels one 100-ton steam locomotive and three small steam locomotives provide motive power. Nine locomotive cranes (six diesel, one diesel-electric and three steam), hopper cars and gondola cars round out the general rolling stock.

Product quality is guarded by extensive laboratory, inspection and observation facilities. A new central laboratory handles almost all chemical analysis. It is equipped with a spectrograph for rapid analysis and is connected to the open hearth and the electric furnaces by pneumatic carrier tube and telautograph.

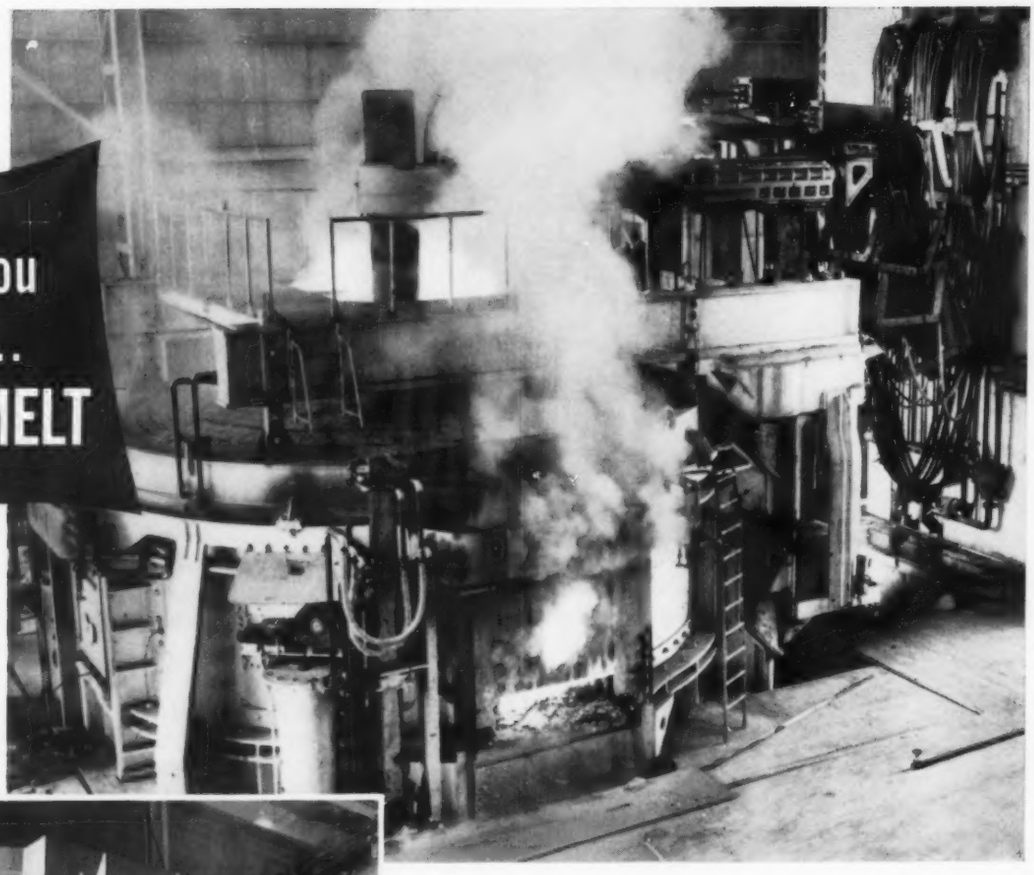
The metallurgical laboratory contains all necessary equipment for the physical testing of plant products. In addition, three departmental laboratories are provided at the wire mill, pipe mill and strip mill to run tests on the department's particular product.

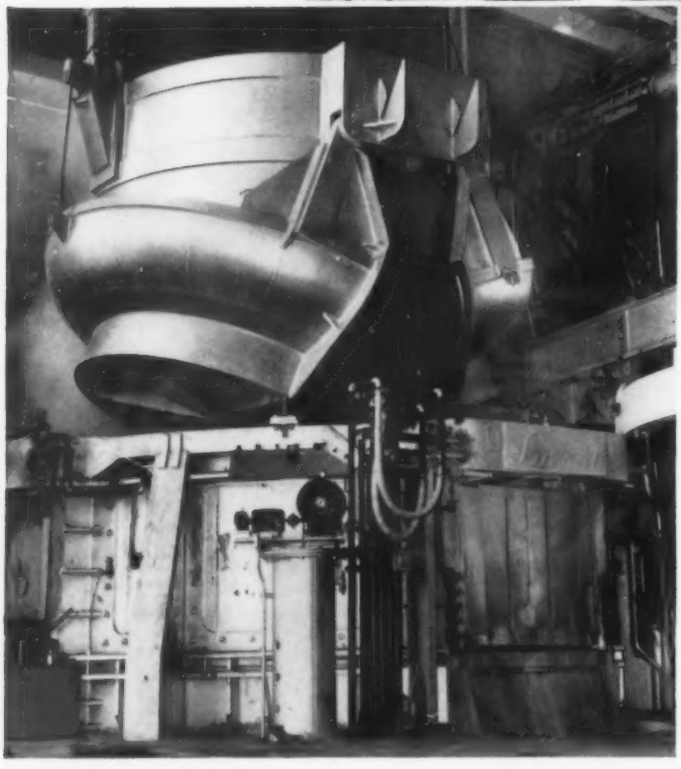
Practice observers are maintained at the open hearth, electric furnaces and blooming mill to insure adherence to recommended procedures. Inspectors maintain close watch on all products before shipment, as well as at critical points in the production processes.

The general office at Gadsden was built shortly after Republic acquired the plant. It has since been enlarged.



When you melt... LECTROMELT





first of a powerful pair

200-ton heats are now being produced in this 24-foot Lectromelt Furnace. A second of similar capacity will soon be installed here in this Southern steel mill.

Catalog No. 10 describes Lectromelt furnace equipment for melting and refining. For a copy, write Lectromelt Furnace Division, McGraw-Edison Company, 310 32nd Street, Pittsburgh 30, Pennsylvania.

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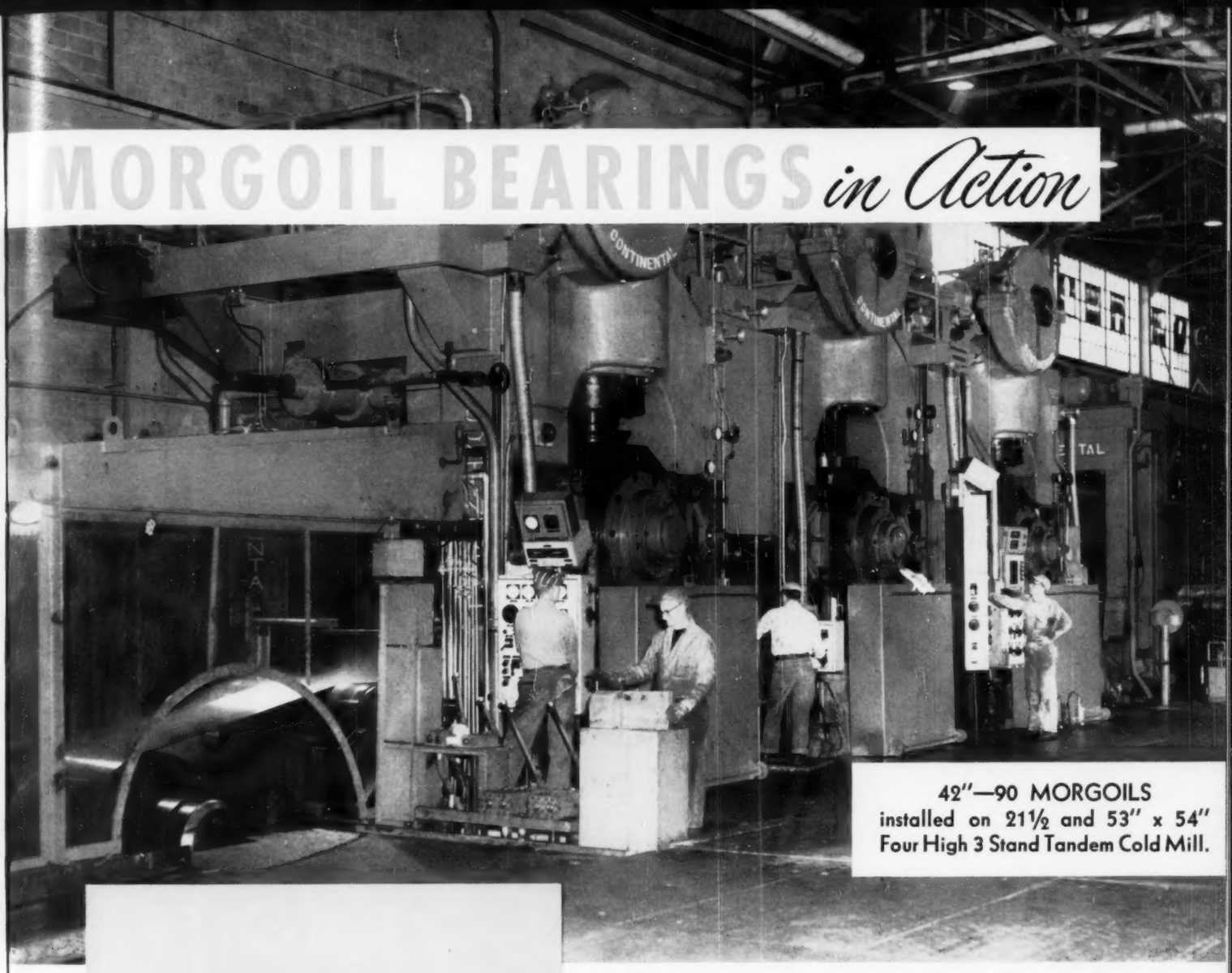
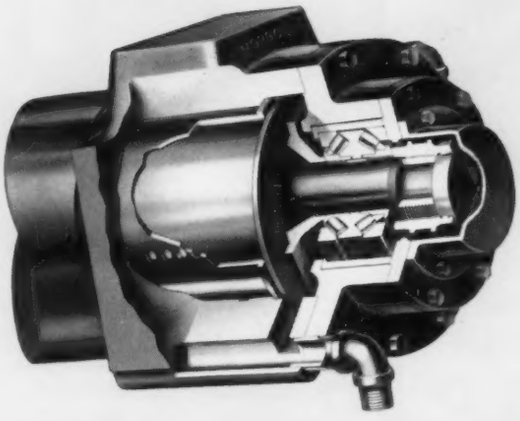
STANDARD SIZES UP TO TWO HUNDRED TONS CAPACITY

MORGOIL BEARINGS *in Action*



42"—90 MORGOILS
installed on 21½ and 53" x 54"
Four High 3 Stand Tandem Cold Mill.



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The Hallden Shear, engineered into a great many of Wean's continuous high speed lines, is furnished to the steel industry by The Wean Engineering Company Inc., Warren, Ohio.

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Bucket crane of the Level-Luffing type operates speedily under EC&M Contra-Torque Hoist Control

Bucket cranes in this fertilizer plant operate at high output with EC&M Contra-Torque Hoist Control

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FAST GETAWAY! Quickly responsive to the frequency of the induced-rotor voltage, **EC&M FREQUENCY RELAYS** match torque requirements to the load. They get the motor up to speed quickly for lowering the bucket and moving the trolley in or out. A lot of time saved between trips!

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SMOOTH STOPPING ELECTRICALLY! *Off-point braking** brings the descending load to rest and the magnetic brake sets to hold the load. Electrical braking has practically eliminated holding brake wear on many cranes now equipped with this feature.

SPEED-LIMITING! Safety on all speeds. These relays (one set for hoisting and lowering) automatically shift motor connections to safeguard lowering operation with far greater skill than human hands.

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—a new EC&M development for AC bucket cranes*

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and there's only one trade-mark like this ☞

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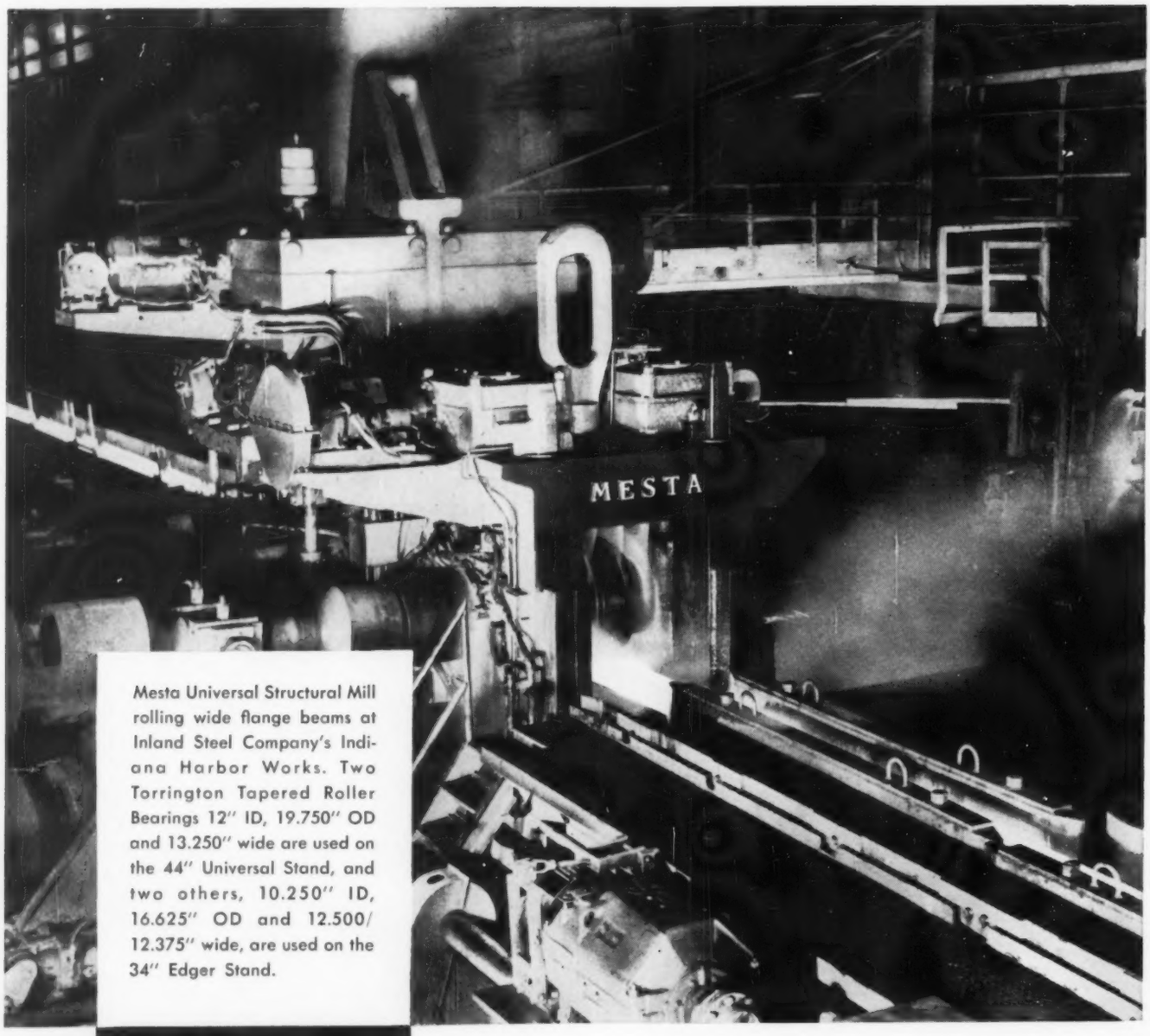
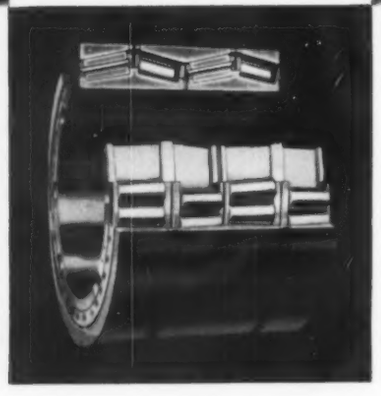
TAPERED ROLLER BEARINGS • REMOVABLE ROCK BITS • FINE ALLOY STEEL



Mesta Universal Structural Mill rolling wide flange beams at Inland Steel Company's Indiana Harbor Works. Two Torrington Tapered Roller Bearings 12" ID, 19.750" OD and 13.250" wide are used on the 44" Universal Stand, and two others, 10.250" ID, 16.625" OD and 12.500/12.375" wide, are used on the 34" Edger Stand.



Keeping production on the beam

Bearing stamina and reliability insure consistent, uninterrupted production of structural steel beams on this 44" Universal Mill and 34" Edging Mill at Inland Steel Company.

Four Torrington Tapered Roller Bearings provide the high radial and thrust capacity to support the vertical rolls.

Every detail of their manufacture, from procurement of electric furnace, bearing quality steel to the final precision grinding, is devoted to one objective—that of providing the steel industry with the finest bearings for long, heavy-duty service.

Torrington Bearings will assist you in establishing rolling mill tonnage records. Call on our engineers for assistance with your bearing problems. Their valuable experience will help insure the value of your bearing dollars! **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

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Republic Steel's Gadsden plant, too anneals the Modern Single Stack way

Fifty Lee Wilson High Convection Furnaces assure Republic of highest quality product

Finest quality annealed product possible—plus the flexibility required in modern-day steelmaking . . . two reasons why Republic Steel has installed 50 Lee Wilson High Convection Single Stack furnaces in three plants in the past three years.

At their Gadsden Plant, pictured above, Republic has 20 furnaces and 60 bases. The Single Stacks require less total area for the same tonnage than larger furnaces would; are easier to control, improve the product and give Republic a versatility in this department unmatched by any other annealing system.

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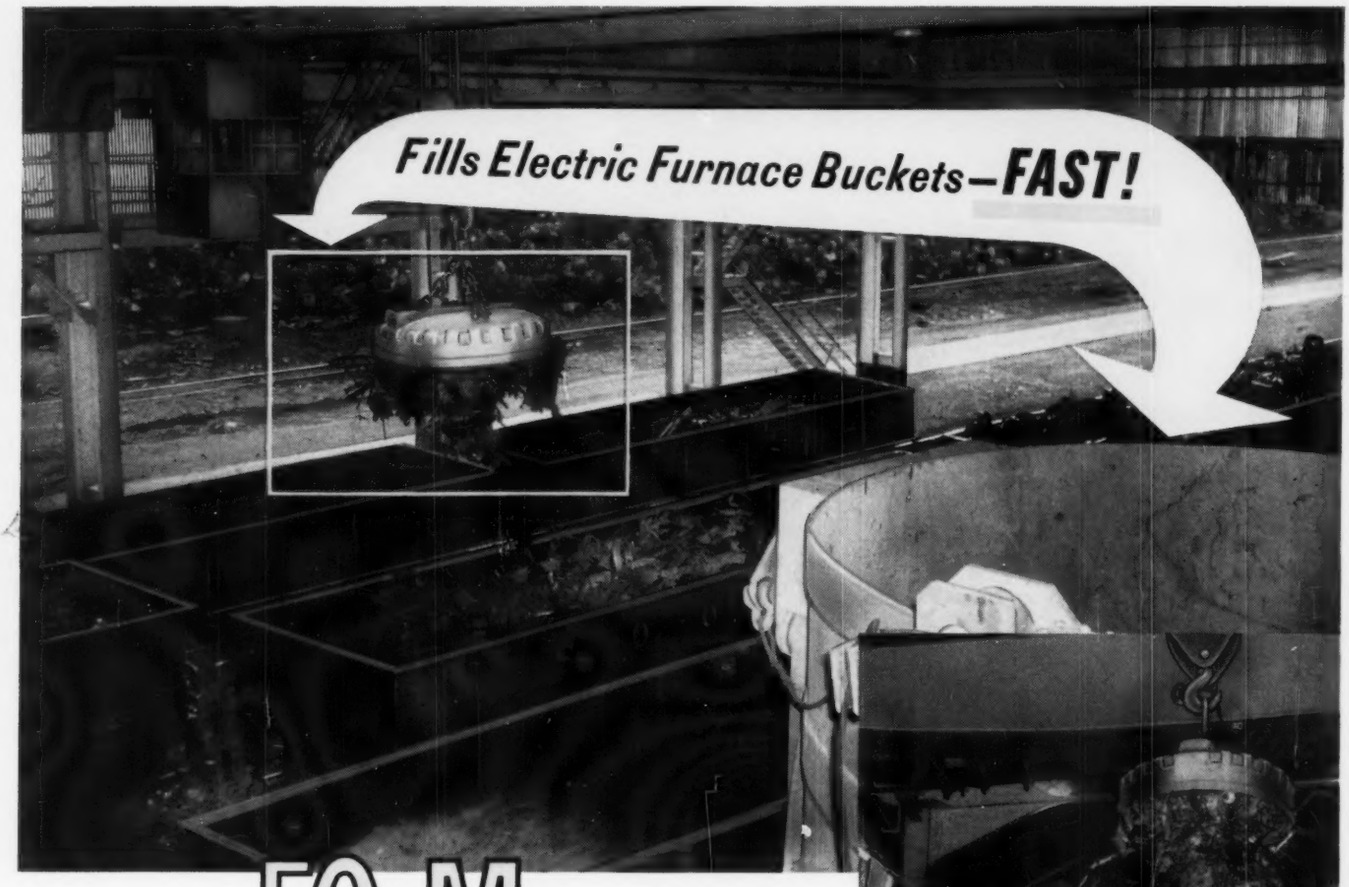

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equals output of two 65" magnets

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Magnet operation is fast, with the EC&M Automatic-Discharge Controller. *Quick-charge* gives high strength for increased pull-away power from the scrap pile. At the unloading point, *Fast-discharge* releases the load quickly and cleanly—eliminates the need for "positioning" the magnet.

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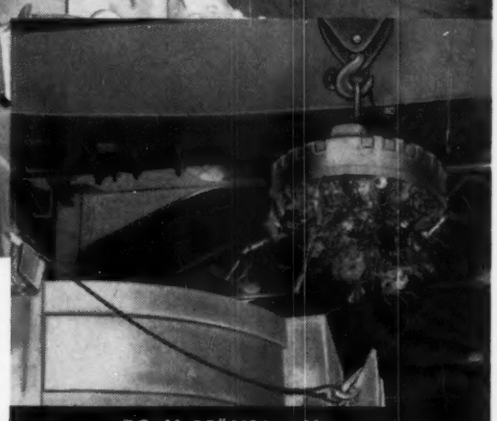

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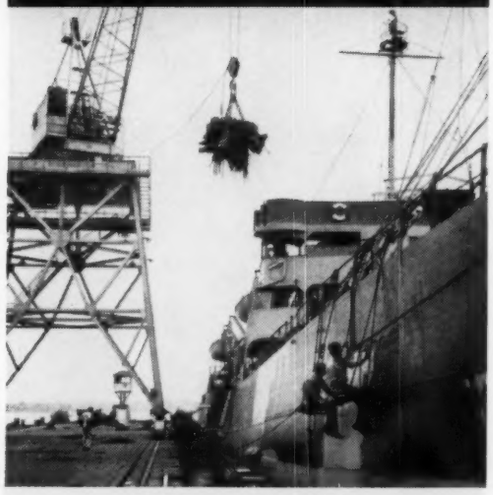

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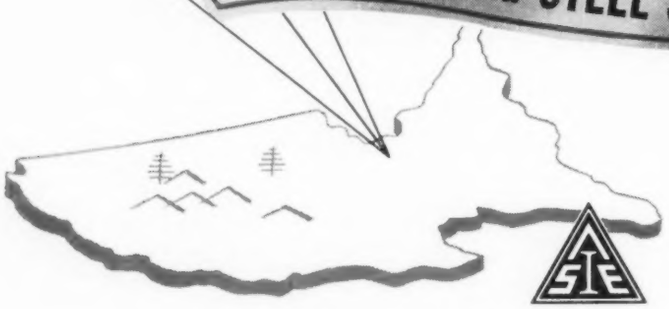

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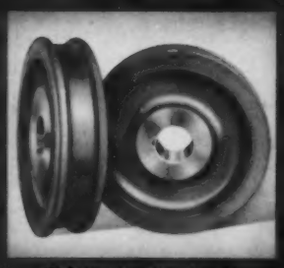

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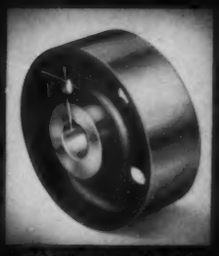

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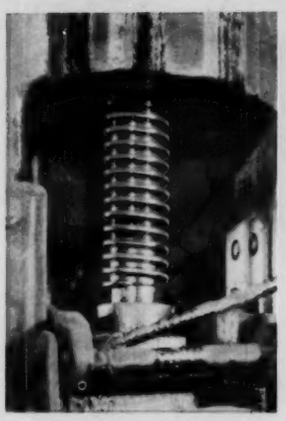

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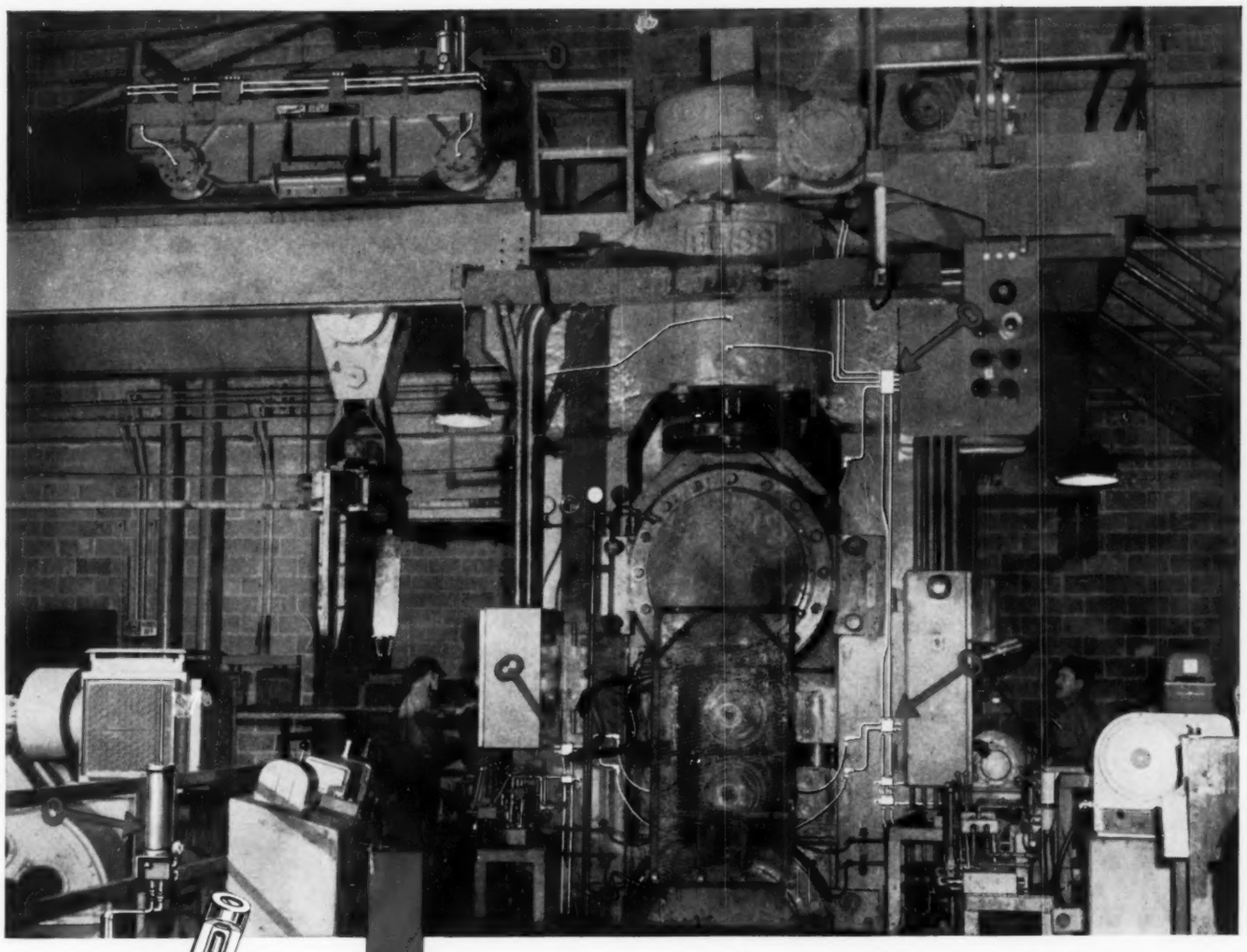

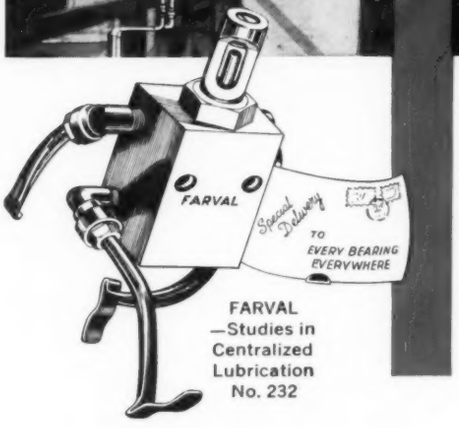

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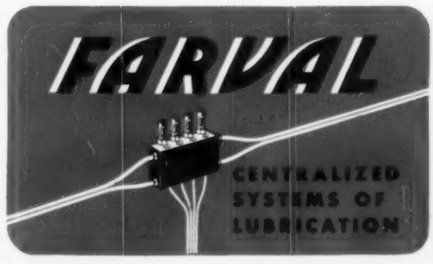

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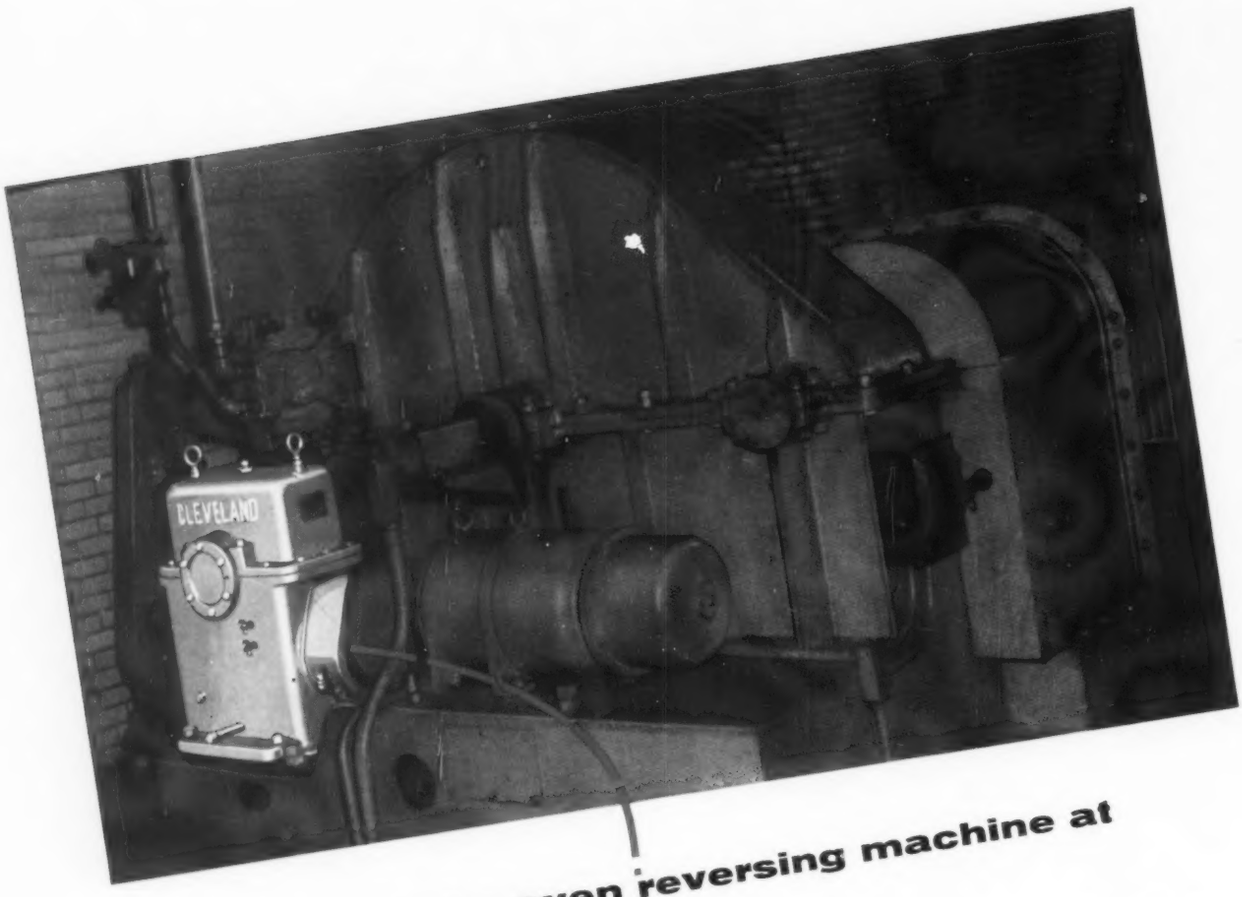

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Fast Annealing of Sheet-Strip Coils with Helium Injection

by J. D. KELLER, Partner Associated Engineers, Pittsburgh, Pa.

. . . . at the 1957 annual AISE convention in Pittsburgh, a very interesting demonstration was given in one of the combustion sessions which indicates that use of helium in stack annealing can radically reduce annealing times . . . .

THE actual annealing of cold reduced low-carbon steel, even to the dead soft state, is accomplished within a few minutes after reaching the annealing temperature. It is not the annealing itself, but the heating-up of the coiled strip to the annealing temperature, and even more its cooling down, that requires excessively long times, with cycles ranging from about 20 to 60 hr or even longer, depending on the size of the coils.

The chief obstacle to rapid heating and cooling of the coils is their resistance to flow of heat within them in the radial direction. In fact, the layers or wraps of strip are equivalent to a fairly good heat-insulating material, having thermal conductivity no greater than that of firebrick. Because of the smooth, reflective surfaces of the strip, radiation from layer to layer is negligible, and the radial heat flow is effected almost entirely by thermal conduction through the thin layers of gas between the layers or wraps of strip in the coil.

Some years ago, the idea was conceived (not by the author) of by-passing this resistance by applying heat to the ends of the coils and having conduction occur in the axial direction, in which the conductivity is much greater. By the use of hollow, open spacers between the ends of the stacked coils, and of high power circulating fans, this was accomplished; the length of the annealing cycle was reduced and the output per base was considerably increased.

This was indeed a great forward step, and those responsible for the development deserve great credit. The improved method, however, also had its drawback and limitations; an obvious one being the large power consumption, which has given rise to the expression "annealing by horsepower instead of by Btu's."

The present paper describes a method which among other, greater advantages, obviates the necessity for circulating fans, by increasing the radial conductivity of the coils at least five-fold. This is done by injecting helium into the narrow spaces between the convolutions of the coils.

All of the heavy gases, such as air, carbon dioxide and monoxide, nitrogen, and mixtures such as de-ox gas, have nearly the same thermal conductivity, which is very low. Only the two light gases, namely, hydrogen and helium, have higher conductivity. Hydrogen has 7 times and helium 5¾ times the conductivity of air. Since the void spaces in the coils are filled with air (in which the coil was wound), and since conduction through the narrow air-filled spaces accounts for at least 95 per cent of the total radial heat flow, it is evident that purging out the air from these spaces within the coil and replacing it with helium must result in increasing the radial conductivity not less than five times.

Despite the straightforward and almost obvious reasoning on which these conclusions are based, doubt is frequently cast on them by those who have not given the matter more than superficial consideration. Therefore, in order to demonstrate the beneficial action of the helium injection in at least a qualitative manner, a small demonstration apparatus has been prepared, a section through which is shown in Figure 1.

Two identical coils of strip are used, about 4¼ in. outside diameter, 2¼ in. inside diameter and 2⅛ in. high, giving a thickness of about one inch of laminations through which the heat must penetrate. The cold-reduced strip is about 0.009 in. thick, and all coils have been wound with as nearly as possible the same tension (about 2800 psi average tensile stress). About 110 convolutions are present in each coil. The third coil, which can be seen at the side, is exactly the same as the two coils in the apparatus, and has been provided to permit examining the winding of the coils.

Identical 500-watt electric heating elements have been inserted in the central holes of the two coils in the apparatus. Each heater has a safety-limit thermostat which will cut off the current if the temperature of the heater reaches 500 F. (The latter temperature is actually never attained before the heat penetrates to the outside of the coils.) The coil at the right in Figure

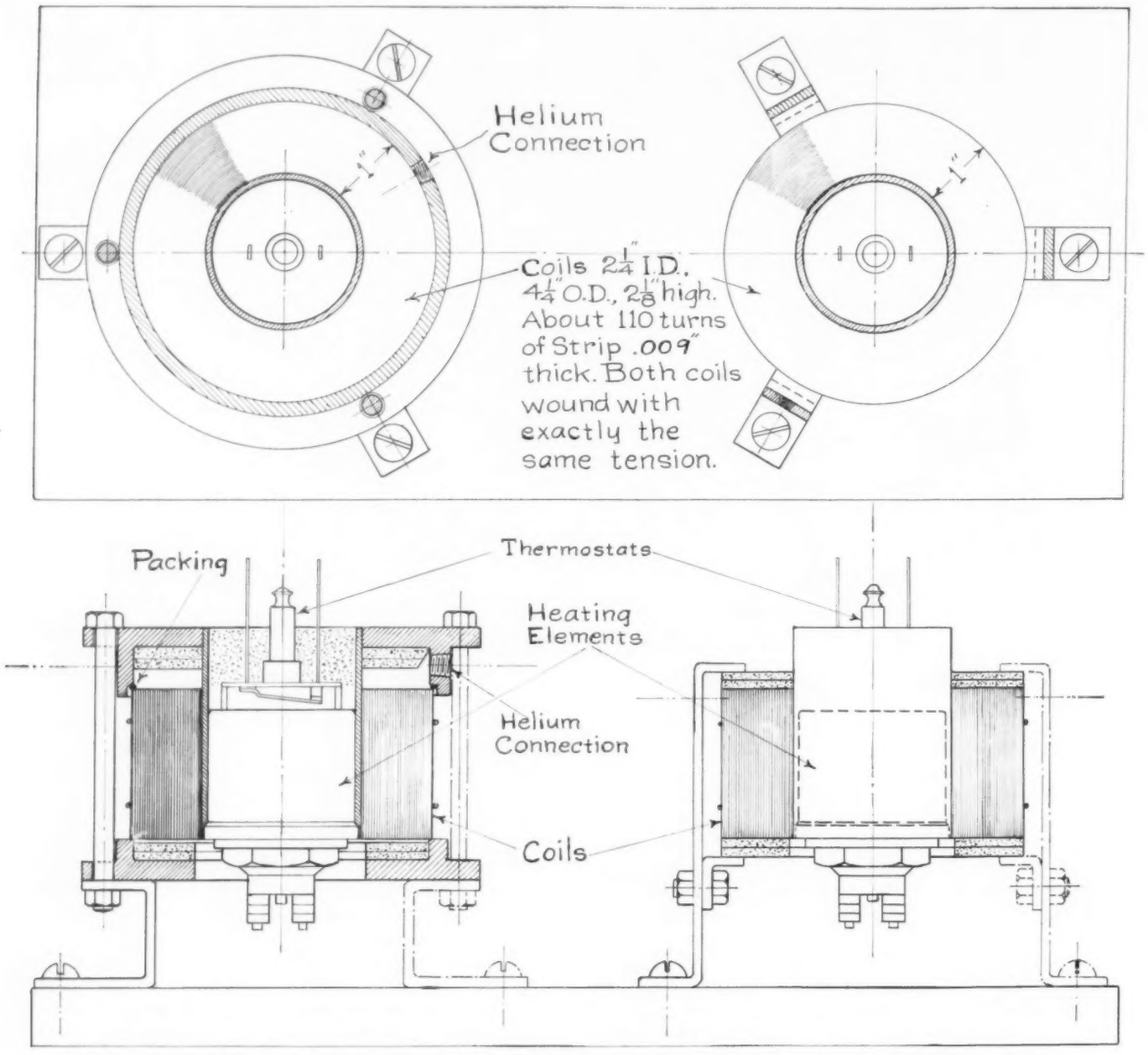


Figure 1 — Small apparatus shown gives a vivid demonstration of the reduced time of heating with helium.

1 is filled with air, just as it was wound. The coil at the left in Figure 1 is provided at the top with a gas-injection chamber, a sealing ring at the outer edge of the coil and a connection to a small steel bottle or cylinder containing helium gas under pressure, with suitable pressure-reducer, gages and regulating valve.

Helium will be caused to flow downward between the convolutions in this coil, at a pressure of about 4 psi, for about ½ to one minute. The lower end-ring on this coil has plenty of clearance to allow the gas to escape at the bottom. The presence of the nonflammable helium is shown by the extinction of a lighted match held underneath this coil.

When the purging and filling with helium has been completed, the electric current will be caused to start flowing through both heaters at the same instant. The time of penetration of the heat through the 110 layers of strip to the outside of the coil, is determined by sensitive mercury thermometers with their bulbs taped to the outside of the respective coils. A rise of 5 F above the initial temperature of the coil exteriors will be allowed, in order to make sure that the heat has actually penetrated through the one inch thickness of laminations in each case.

Usually, slightly less than four minutes will be required for the heat to penetrate through the helium-filled coil, and somewhat less than seven minutes for the air-filled coil. Since about a minute is required initially to raise each heating element to a temperature sufficient for it to begin to impart heat to the inside of its coil, it will be evident that heat penetrates at least twice as fast through the helium-filled coil as through the air-filled coil.

As stated before, this is not intended as a quantitative test of the time-saving of the new method in full-scale annealing operations. Nevertheless, it does convincingly show that a radical speeding-up of the heat conduction within the coils can be effected by the in-

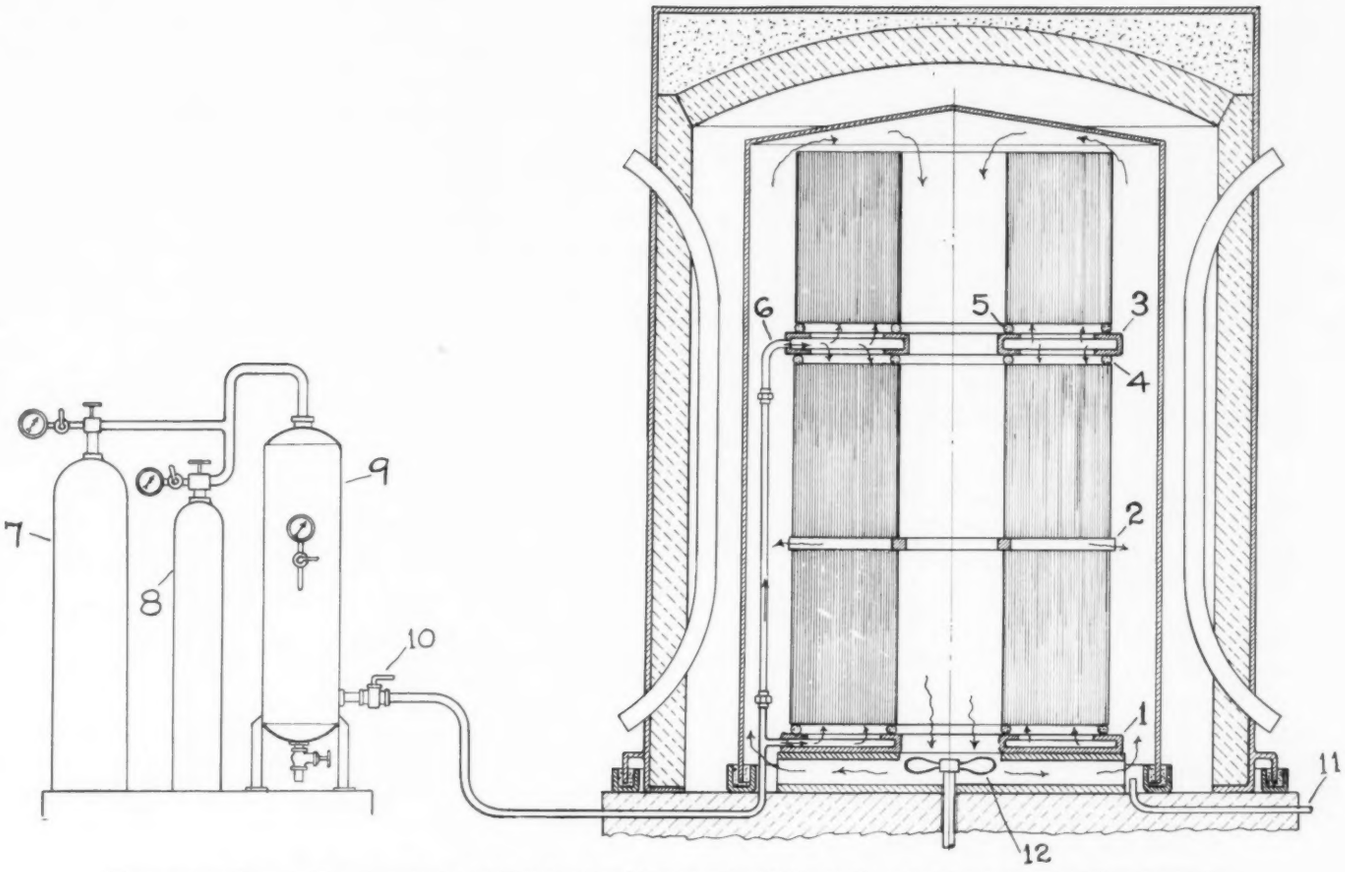


Figure 2 — Proposed arrangement for injecting high conductivity helium into a coil annealing furnace.

jection of helium.

As regards application of the new method to full-scale annealing, Figure 2 shows the proposed arrangement for injecting the high-conductivity gas. Items 1 and 3 are hollow spacers, the former having openings in its top only, and the latter having openings in both its top and bottom faces. Items 5 and 4 are seating means at the inner and outer edges of the coils. No. 2 is a dummy spacer or spider to permit egress of the purged gas from the ends of the coils away from the charging spacers. Often the ends of the coils are sufficiently uneven to permit escape of the purged gas radially between the adjacent ends of the coils, in which case spiders 2 can be omitted.

When the spacers and coils have been properly stacked as shown, the unions in the flexible stainless steel pipe 6 are connected, the inner cover is put in place over the coil stack, and the unit is ready for the helium injection. Helium from steel bottle 7, together with the proper percentage of hydrogen or other gas from bottle 8, is allowed to flow into a 30-gal steel tank 9, with valve 10 closed, until the desired pressure in 9 has been reached. Then the quick-opening valve 10 is opened wide, and the high-conductivity gas is allowed to flow rapidly into the hollow spacers and from them through the coils for about a minute. The outer cover is put in place and the heating begun.

During the heating part of the cycle, it is expected that no additional injection of helium will be necessary. During the cooling period, either a slow seepage of helium through the coils, or preferably intermittent brief puffs, or "shots" of helium, may be used to prevent the drawing-in of gases from the space between the inner cover and the coils (due to thermal contraction of the gases as the coils cool) and to maintain the helium atmosphere between the strip layers in the coils at all times, even at the coil ends adjacent spacers 2.

Helium need not be used to fill the space between the coil exteriors and the inner cover, since it would have little advantage there. Ordinary de-ox gas can be supplied through inlet 11, and circulated by a low-power fan 12; although such circulation is really unnecessary because of the five-fold increase of radial conductivity due to the injected helium, which carries the heat inward as rapidly as could be desired.

In the application of the new method, the chief problem is that of sealing the inside and outside edges of the coils to prevent leakage of the expensive helium gas; especially since the coils, although all of the same inside diameter, may vary several inches in outside diameter. Unevenness of the coil ends must also be taken into account. In Figure 3 is shown a method of sealing which is believed to be entirely feasible, though not necessarily the best method that could be developed. Rings of rope asbestos are used underneath spacer 3 at inside and outside edges of the coil below it, and on top of both spacers 3 and 1 (referring to Figure 2) at the inner edge of the coil above.

At the bottom outside edge of the coil being lowered onto spacer 1 or 3 of Figure 2, a ring of "tadpole" asbestos packing is used, being held to the coil above it by friction exerted on the tail of the tadpole by tension in the split stainless steel band produced by a garter

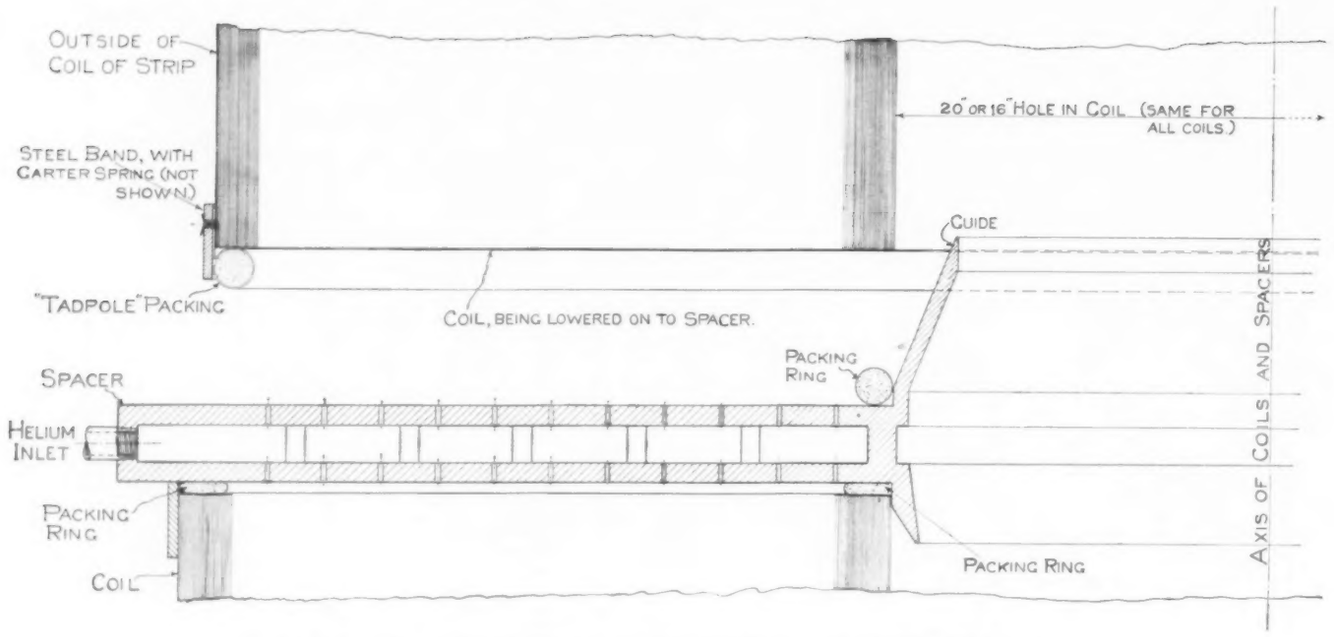


Figure 3 — Satisfactory results are expected from this method of sealing.

spring (Figure 4). After the coil has been lowered into place and the packings are held in place by its weight, the garter spring and steel band are removed for use on other coils higher up in the stack.

It may be desirable to wrap the asbestos in aluminum foil in order to reduce leakage.

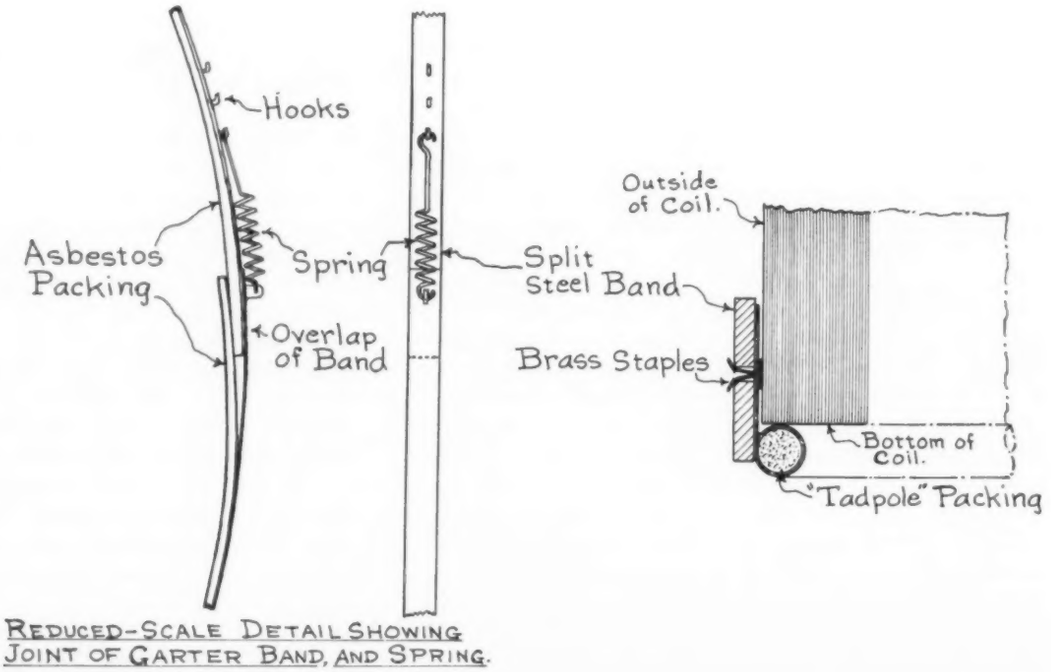
It is believed that the coils can be sorted in such manner that in any one stack the coil outside diameter will not vary more than 2 in. In that case there would be no coil in which more than 1 in. thickness at the outside would not receive helium by axial flow. And since the gas also flows spirally toward the outside, the reduction of conductivity due to lack of helium in the outer layers of any coil is believed to be negligible.

As an alternative, the coils may be stacked without spacers, as in Figure 5, the top closed by a plate 13 and helium injected into the central hole and allowed to flow spirally outward, escaping at the outside of the coils into the space under the inner cover. A considerably greater variation of coil outside diameter could be coped with in that case. Probably, in order to avoid excessive leakage outward between the rough ends of the coils, seals 14 and 15 would have to be used here. These could be sheets of asbestos enclosed in stainless steel foil. There are, however, several objections to this method of helium injection.

In any case, it seems certain that satisfactory sealing means can be devised which will not cause appreciable delay in stacking or objectionable increase of cost.

The use of helium has been questioned from the economic standpoint, because helium is an expensive

Figure 4 — Schematic shows method of using tadpole packing at lower outside edge of coil.



REDUCED-SCALE DETAIL SHOWING JOINT OF GARTER BAND, AND SPRING.

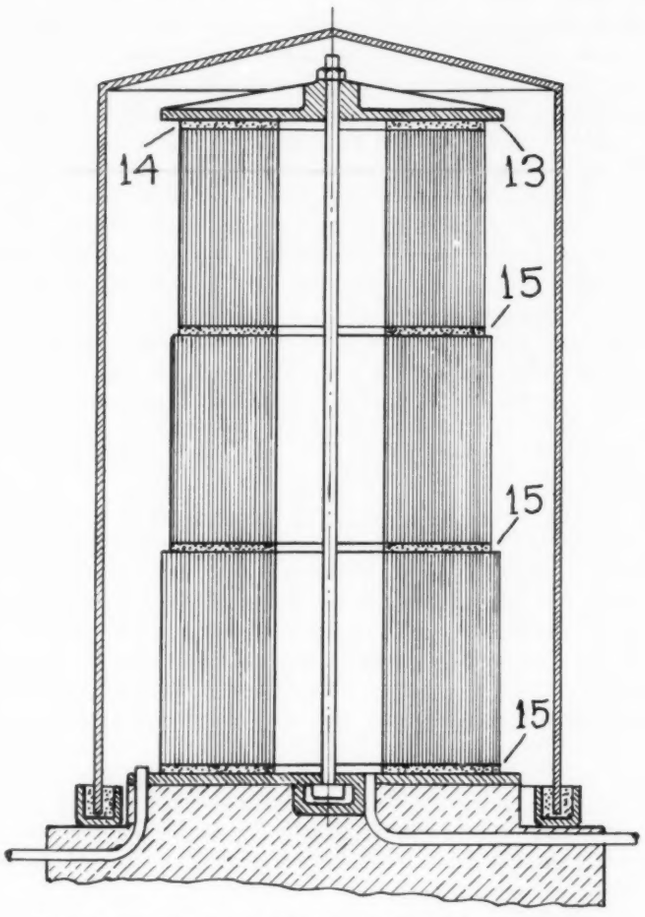


Figure 5 — Coils may also be stacked without spacers.

gas, costing 5 to 6 cents per cu ft in steel bottles, or 1½ to 2 cents in tank car lots. However, the quantity required to fill the narrow spaces between the convolutions of strip in the coils is so small—usually about ⅛ cu ft per ton of strip—that even allowing 10 times the volume for purging, the cost of the helium works out at only about 3 cents per ton of strip.

As to availability of helium, inquiry some years ago of the government plant at Amarillo, Tex., where the helium is extracted from natural gas, established the fact that ample quantities of helium were at that time available to handle the annealing of the total tonnage of strip coil-annealed in the entire U. S. A.

The advantages expected from the use of helium injection in the annealing of sheet-strip coils are the following:

1. An increase of production of at least 50 per cent, and probably much more, over the best present convector-type furnaces using high-power fans. This increase should be attainable even with inner covers and with radiant-tube heating as at present.

2. Concurrently, reduction of the temperature inequalities in the coils to 50 per cent (or less) of what they are in present practice.

3. Elimination of the need for high-power circulating fans.

4. The making possible of the use of direct-fired annealing covers (not requiring alloy tubes) without any danger of overheating the coils locally.

5. Eventually, the possibility of dispensing with the inner or "ash can" covers, heating by direct firing, and cooling by spraying water directly on the outside of the coils. This is possible because of the more than five-fold increase in the radial conductivity of the coils. It will require sacrificing the outer wrap or convolution of each coil, but all the inner layers will be protected by the helium. The rate of production per base will be still further increased thereby, to an estimated 220 per cent of best present practice or possibly even more, with equally good uniformity of annealing.

6. Avoidance at all times of blued edges on the strip. This will be advantageous for subsequent coating such as electrotinning or electrogalvanizing, because the nonuniform coating thickness resulting from the blued edges (even after pickling), and the consequent variation of corrosion resistance from middle to edges of the strip, will be eliminated.

7. The injection of helium may permit coil annealing to be used for stainless steels of the plain chromium grades, such as No. 430, without the formation of "green rot" on the strip surfaces, or pock-marking, which at present make coil-annealing of these grades extremely difficult if not impossible.

8. Less trouble from sticking, because of lower maximum temperature in the coils. The practice of re-coiling to prevent sticking, as done in some plants at present, may be rendered unnecessary by helium injection.

9. Probable avoidance of "carbon smut" on the surfaces of the strip. This smut results from the carbonization of the rolling oil which remains in the pores of the strip surface. It is formed when the gas layers between the wraps of the coil are stagnant; whereas the helium injection should sweep away the vaporized oil before it can carbonize.

Discussion

PRESENTED BY

GEORGE CAMPBELL, Assistant Fuel Engineer, Bethlehem Steel Co., Sparrows Point, Md.

J. D. KELLER, Partner, Associated Engineers, Pittsburgh, Pa.

JAMES E. HOVIS, Vice President in Charge of Sales, F.E.I. Inc., Cleveland, Ohio

EDWARD M. YARD, Chief Project Engineer, Mechanical, John A. Roebling's Sons Corp., Trenton, N. J.

NEIL LAIDMAN, Engineer, Physical Metallurgy Section, Research Dept., Bethlehem Steel Co., Sparrows Point, Md.

George Campbell: We have done some work on measuring the evolution of gases in coils during the heating cycle and we have found, that in both tinplate, which has been washed, and sheet coils, which have been unwashed, there is considerable evolution of gases which takes place well up into the soak period, and it is my opinion that with helium injection it will be necessary to continue the helium flow well up into the soak period in order to replace these gases with the higher conductive helium.

J. D. Keller: What Mr. Campbell has said seems quite possible. Little has been known about the evolution of gases from the steel itself, but certainly there is some, and probably a large part of it comes from the rolling oil which is pressed into the surface of the strip

during the cold reduction to such an extent that it is very difficult to remove. That is undoubtedly vaporized and produces some gas which fills the space and usually is cracked when it comes up to a certain temperature, and thereby produces the carbon smut to which I referred.

However, it is all again a matter of quantitative evolution of the gas. In other words, if that gas quantity is comparatively small, it is likely that the dilution of the helium already present will not be sufficient appreciably to decrease the thermal conductivity. On the other hand, if the evolution of gas is really copious it may be necessary to give a shot of helium occasionally during the heating part of the cycle as well as previously mentioned during the cooling part of the cycle.

That is something that should be determined by experiment. What is really desired at the present time is the opportunity to make a test—a scientifically comparative test—on full-size coils at actual annealing temperatures.

I think the demonstration apparatus has shown without question that the helium does greatly increase the rate of heat penetration in the coils at a low temperature, but unfortunately some people, of course, are not convinced until you get a full-size coil, and then again there is the question of the lower temperature. The evolution of the gas from the steel, which Mr. Campbell has referred to, would not occur at the temperature we have in the demonstration apparatus. However, tests are about to be made on annealing brass strip and while that is at a somewhat lower temperature and we may not have the same effect as to gas evolution, it should give a comparative idea on a full-size coil of the time to be saved and the increase of production to be expected by the injection of helium.

James E. Hovis: The only thing I would like to get some clarification on is this: You have stated that 98 per cent of the heat transfer was by conduction radially through the layers of gas between wraps of the coil and roughly two per cent by radiation. Prior to the advent of the high-convection fan, this may have been true. You have mentioned no figure for the end conduction. I would certainly think that we now have a very substantial part of heat transfer attributed to end conduction. You infer that we get an increase in transfer rate radially of about five-to-one due to the difference in conductivity between, say, air and helium.

Later on in your paper you mentioned a 50 per cent increase in production due to the packing with helium. These figures in a sense do not add up and I wonder if you would clarify these—your five-to-one figure, the effect of end conduction, and why we are down to only 50 per cent increase in production.

J. D. Keller: Mr. Hovis' questions are very good and there is something that requires explanation there. In the ordinary coil, if we go back to practice before the convectors were used, at least 85 per cent of the heat was transferred radially and of that, at least 95 per cent was transmitted by conduction. The difficulty is, in comparing with the later design using the convectors, to know just how much increase was obtained by using the convectors over the old-style coils without the convectors.

It happens that I was connected to quite an extent with the development of the convectors, laying out the shape of the guide vanes, and so forth, and making the calculations for them, I later had opportunities to compare the advantage obtained, but you find this situation: Between various plants you get extremely varying ratios of the increase produced by the convectors. Now, I do not want by any means to discourage use of the convectors. It was a great advance, no question. But we have to remember that with convectors you first have to abstract heat from the double-walled, or double layer, "ashcan" cover. Then you have to take that gas around through the convector and transfer the heat from the convectors to the end of the coil and then conduct it endwise in the coils. The endwise conductivity is very good, but the problem is chiefly in getting sufficient heat from the outer to the inner cover, into the gases and from the gases into the end of the coil so it can be conducted axially.

As nearly as I have been able to make out, it is something like this: We have an increase, by the use of the convectors, of, some say 50 per cent; others say 100 per cent. Without convectors but with helium injection, if we were able to bring up the outer surface of the helium filled coil to the annealing temperature almost instantly, we would, as I said, effect a five-fold increase. But the difficulty is that we cannot bring that outer surface up quite as fast with the present type of heating because we transfer nearly all of the heat by radiation. Therefore, it is a little difficult to name exact proportions, but, as nearly as I have been able to figure it, the gain in production over the convector heating should be at least 50 per cent compared with present practice using the radiant tubes and the inner cover.

As to the rest of the potential five-fold increase, what you do not gain in output, you do gain in reducing the temperature difference within the coil and thereby getting greater uniformity of annealing.

However, as stated toward the end of the paper, it is expected that eventually, by using helium injection, it will be possible to do away with the inner cover entirely, do away with the tubes, and direct fire around the outside of the coils, sacrificing the outer layer, which will be necessary—it will become blued, of course—but the inner layers will all be protected by the helium. Under those conditions, it should be possible to attain about a five-fold increase, at least, as compared with the old style without the convectors and, as I said, probably about 220 per cent increase compared with the use of the convectors as at present.

Edward M. Yard: We have experienced something similar. We operated a great many annealing covers using the dissociated ammonia atmosphere with up to 75 per cent hydrogen. And we both believed and found that on inner covers where we had no circulating fan at all, that we could detect an increased heating rate using that atmosphere as compared with a de-ox atmosphere. However, as soon as we obtained furnaces having fans giving an appreciable amount of circulation, we found that the difference was cut down, and with high convection annealing covers we find there is no difference whatsoever. We do not know whether this would have any bearing on the problem, but we were interested to note that as soon as we obtained very high circulating rates, evidently convection dominated the picture and the increased conductivity was not really helping us.

I do not know whether that has any bearing on this but I would like to hear your comments on it.

J. D. Keller: Mr. Yard has a very good point there and one which gives me an opportunity to emphasize something that I may not have made clear, and that is, the place where the helium is of value is in those small spaces between the wraps of the coil. In ordinary tinplate strip, for example, those spaces have an average thickness of about 0.0003 in., and it is in those spaces that helium is of value. The helium around the outside, between the "ashcan" cover and the outside of the coils, is practically of no value because the distance through which the heat would have to be transmitted by conduction is so great that even though the helium has 5¾ times the conductivity, still the distance is so great that the gain is very small compared to the transmission of heat by radiation. Nearly all the heat, except when convectors are used, is transmitted by radiation from the inner cover to the outside of the coil.

What Mr. Yard found, I think is perfectly correct. As long as there was no circulation, probably there was some penetration of the hydrogen-containing gas—(about 75 per cent hydrogen)—by natural diffusion, into the narrow spaces of the coil, and the total rate of heat transfer being small, the effect of the hydrogen was enough to be noticeable. But when the circulating fans were used, there was no increase of conductivity because there was no flow of the high conductivity hydrogen into the small spaces between the wraps of the coil; on the other hand, there was a great increase of the total heat transfer by the circulation of the gases, so that masked and diminished the effect—the percentage effect—of the possible slight diffusion of hydrogen into those spaces. I want to emphasize that fact because it is so hard to explain to people with whom I have discussed it. They immediately think of helium around the outside of the coil. Now, that is of very little value. That was tried at Jones and Laughlin many years ago, and had no appreciable effect. But if you can get the helium in between those layers in the coils, into those 0.0003-in. spaces, that is where you increase the conductivity and speed up your heating, or decrease your heating time and your cooling time.

Neil Laidman: Your paper raised a couple of questions in my mind. These were very small coils used in your experiment. Would the same penetration of helium take place on a full size coil, 30 in. wide, 56 in. in diam, weighing about 15,000 lb.? Has any attempt been made to see if the helium penetrates down into each lap of a full sized coil?

The point is that one might successfully purge a coil with helium while the coil is cold. However, once the coil started to be heated, the gases and oil on the strip would tend to drive the helium out of the laps of the coil. Therefore, would it not become necessary to have a continuous purge of helium?

J. D. Keller: Nearly everyone is likely to feel some distrust of extrapolating from a small coil of this size to a much larger coil. However, we know from the laws of fluid flow that there should be no difficulty in getting the helium to flow through the wraps of the coil in the small spaces because, although each one may be only 0.0003 of an inch thick, if you figure that the area is about three per cent of the area of the coil, you can see that you have something on the order of at least a square foot of area through which the helium can flow, and since the layers are all wrapped with the same tension, the width of the space must remain practically the same, so that the flow between any one space and the adjacent spaces must be somewhere near the same. Since a purging factor of ten has been allowed, I think there cannot be much doubt about the fact that we can get the helium in, in the full-size coils. ▲

Available Transactions

As a service to readers of the *Iron and Steel Engineer* a list of translations from foreign articles is being printed intermittently. Articles selected for this listing will be those thought to be of primary interest to the American steel plant operator. Those papers listed with a number only may be obtained from the Cooperative Translation Service, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S. W. 1, England. All correspondence concerning price, ordering and so forth should be directed to the source.

554 SPETZLER: "An Assessment of Various Furnace Linings," *Stahl u. Eisen*, 1956, vol. 76, December 27, pp. 1734–1740.

634 TRUBIN: "Advantages of Tilting as Compared with Fixed Furnaces," *Stal'*, 1956, No. 9, pp. 780–782.

635 LENORSKY et al.: "Comparison between Tilting and Fixed Furnaces," *Stal'*, 1957, No. 5, pp. 411–413.

622 KLARDING: "Noise Measurements for Control and Conduct of the Blow in the Bessemer Process—Parts I and II" (Summary), *Metall*, 1955 September, pp. 780–783; 1956, May, pp. 405–415.

637 KOSMIDER and SCHENCK: "Dephosphorization of Basic Converter Steel to Very Low Contents of Phosphorus," *Stahl u. Eisen*, 1957, vol. 77, July 11, pp. 917–926.

710 SPRINGORUM et al.: "Experiences and New Findings in Refining of Basic Bessemer Pig Iron by Blowing with Pure Oxygen," *Stahl u. Eisen*, 1957, vol. 77, No. 19, September 19, pp. 1284–1296.

615 LEITNER: "Experiences with the Application of Basic Brickwork in O. H. Furnaces," *Neue Hutte*, 1957, No. 2/3, February/March, pp. 152–154.

583 HESSE: "Behaviour of the Surface of Rolls in Rolling," *Stahl u. Eisen*, 1957, vol. 77, May 30, pp. 715–727.

577 CHATEL et al.: "Study of Ridge Formation in Hot Dip Tinning," *Metaux-Corrosion-Industries*, 1955, pp. 78–87.

736 LIKSHIKS and SOCHAM: "Oxygen Utilization in a 250-ton Open-hearth Furnace," *Stal'*, 1957, May, pp. 402–405.

740 MATVEEV: "The Tube Industry of the U.S.S.R.," *Stal'*, 1957, November, pp. 997–1005.

DISTRIBUTING RAW MATERIALS IN BLAST FURNACES

by HENRY W. CAMPBELL, Chief Engineer,
Interlake Iron Corp., Cleveland, Ohio

Operating data on blast furnace operation with the spinning top on a number of furnaces at Interlake Iron indicate higher iron production, lower coke rates, and lower flue dust production . . . . in addition to economies, longer furnace life is indicated.

THE desirability of good distribution of raw materials in a blast furnace is well known and has been the goal of blast furnace operators and engineers for years. In the days of the hand-filled furnace when the buggies of ore, coke and limestone were taken to the top platform of the furnace on an elevator, the man who wheeled the buggy to the bell knew that he should dump the material at different locations on the bell so that he would get the desired uniform distribution. Then with the advent of the skip-filled furnace, it was quite obvious that the skip car would always dump in the same place and the resulting distribution would be quite poor. The generally accepted method of correcting this condition was the use of the 6-point distributor, the operation of which is quite well known to all blast furnace men.

The blast furnace operators, definitely those in the Interlake Iron organization, realized that the 6-point distributor was not the final solution to the distribution in furnaces equipped with a double skip for two reasons.

First, the material would be piled high at a different location in the revolving hopper when the right skip dumped than would be the case when the left skip dumped.

Second, the location of the material peak would be different for different materials due to the paths they took through the funnel-shaped receiving hopper because of the physical natures of the materials. Specifically, coke passing through the receiving hopper would swirl farther around in the hopper than any of the other materials and some very mucky ores would not swirl at all.

In view of the above, the 6-point top would give a regular distribution of an irregular distribution and the technical minded people of Interlake were never satisfied with this condition. Several ways were tried to correct this—by building the revolving hopper as slender as practical in order to make the ratio of the volume of the peak to the volume of the cylindrical portion of the stock as small as possible, by putting retarding vanes in the receiving hopper to eliminate the swirl of the stock, and by making the receiving hopper rectangular in order to eliminate the swirl resulting in a conical hopper.

The two furnaces at Chicago were single skip furnaces and since the peak of the stock in the revolving hopper was always located in the same spot, it was evident that the distribution was better with the 6-point top on these furnaces than on the double skip installations. This was so much so that when considering the building of two new larger furnaces in 1950, an additional large sum of money would have been spent to provide a single skip large enough and fast enough to keep these furnaces full if the spinning top method, installed during relining jobs on the two Toledo furnaces in 1951, had proved unsuccessful.

The fundamental idea for the new top was to rotate the hopper fast enough so that it would make one complete revolution during the period of time required for the stock to pass from the skip car into the revolving hopper. A great number of material dumps were timed and it was found that coke dumped the quickest and required three seconds or more. This meant that the revolving hopper should have a speed of at least 20 rpm. Since the conventional hopper rotated at about 2 rpm, it appeared that it was a big problem to rotate it at ten times the usual speed. The big problem was the seal between the rotating and stationary elements. For many years water seals had been used on the Chicago Federal furnaces and it was decided that this would be the ideal seal. The top pressures at Toledo ran about 20 to 30 in. of water so the distributor was designed for a 60-in. seal and it may be of interest to note that this seal design has been successful for the past six years on this pressure (See Figure 1). The existing distributors were conventional units with supporting rollers (not balls and races) and with asbestos rings for sealing. In the design for the trial units, the existing supporting rollers, and the existing speed reducer equipped with gears for the proper ratio to give 20 rpm and a new 30-hp motor were used. The existing small bell swivel, which was the old Julian Kennedy ball and race type, was used. See Figure 1A. In designing the unit, provisions were made to quickly and easily go back to the 6-point method if the spinning top idea were a failure. In fact, the electric control panel for high speed was so arranged that by throwing a few double throw switches, a shift could be made to the 6-point control panel. The switches were never used, however, and on the later installations no provisions were made for going back to 6-point operation.

The next installation was on the new furnace at the Erie plant where a venturi type gas washer was to be installed and the increased top pressure made a straight water seal impractical. The seal was therefore designed

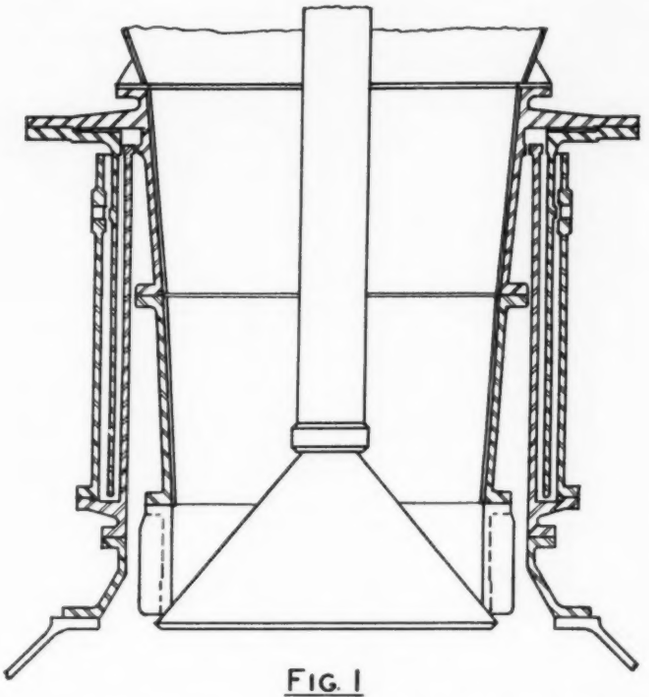


FIG. 1

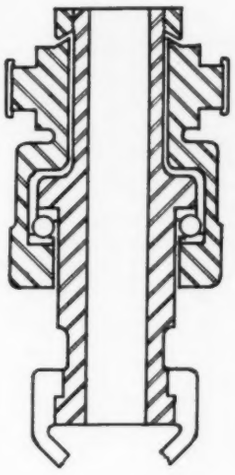


FIG. 1A

Figure 1 — The waterseal shown on the left and the ballbearing swivel on the right have given successful operation for over six years.

to use six laminated plastic rings in grooves machined in the rotating element of the water seal as shown in Figure 2. The stationary or outer element of the seal was divided into an upper and lower section and the rings were opposite the lower section. This lower section was divided into four sections vertically and flanged so that one section could be removed without disturbing the other parts of the distributor. The plastic rings were made in six sections so that these sections were shorter than the sections of castings which would permit easy replacement of the rings as they wore out. The segments of rings were anchored into the grooves of the rotating element by pins which were threaded into the grooves and extended out to engage elongated holes in the rings. The rings were held against the surface of the outside stationary sections of the seal by means of corrugated stainless steel strips placed in the grooves behind the rings. The seal was satisfactory from the standpoint of holding back the gas on moderately high top pressures about 60 to 70 in. of water. However, the stainless steel strips soon failed at the tops of the corrugations probably due to both wear and flexing. These spring strips were then replaced with coiled stainless steel springs but, although an improvement, they were not entirely satisfactory.

The next installation was on the new Chicago "A" furnace which was going through the design stage at the time the Erie furnace was blown in. Since the laminated plastic ring troubles became apparent at Erie shortly after the blow-in, the design was changed. See Figure 3. The grooves were cast and machined in the stationary element and no attempt was made to anchor the rings to keep them from turning. A stainless steel, sectional band with the ends of each section bent out and drilled to receive stainless steel bolts which could be tightened to draw up the sections of the band was used, thereby holding the sections of micarta ring tight against the surface of the rotating member.

It was quite evident that any seal to be satisfactory must seal against higher top pressures than normal for Interlake furnaces. A septum valve had been installed in the gas main at Erie to produce higher than normal top pressures, so it was decided to introduce grease into the seal on this furnace to determine what pressure the plastic rings would successfully seal with a viscous fluid. The first trial was made with grease forced into the seal between the two sets of rings and with water introduced above the upper set so that any grease working through past the rings would be carried off in the water overflow. This was not successful due to an emulsification of the grease and water and the seal was then placed on all grease which proved effective for sealing against pressures up to about $3\frac{1}{2}$ psig.

The plastic rings on both the Erie and Chicago furnaces showed considerable wear after about six months of operation and, while it was not a major job to renew the laminated plastic, a considerable amount of thought was given to a better seal and material. The most prom-

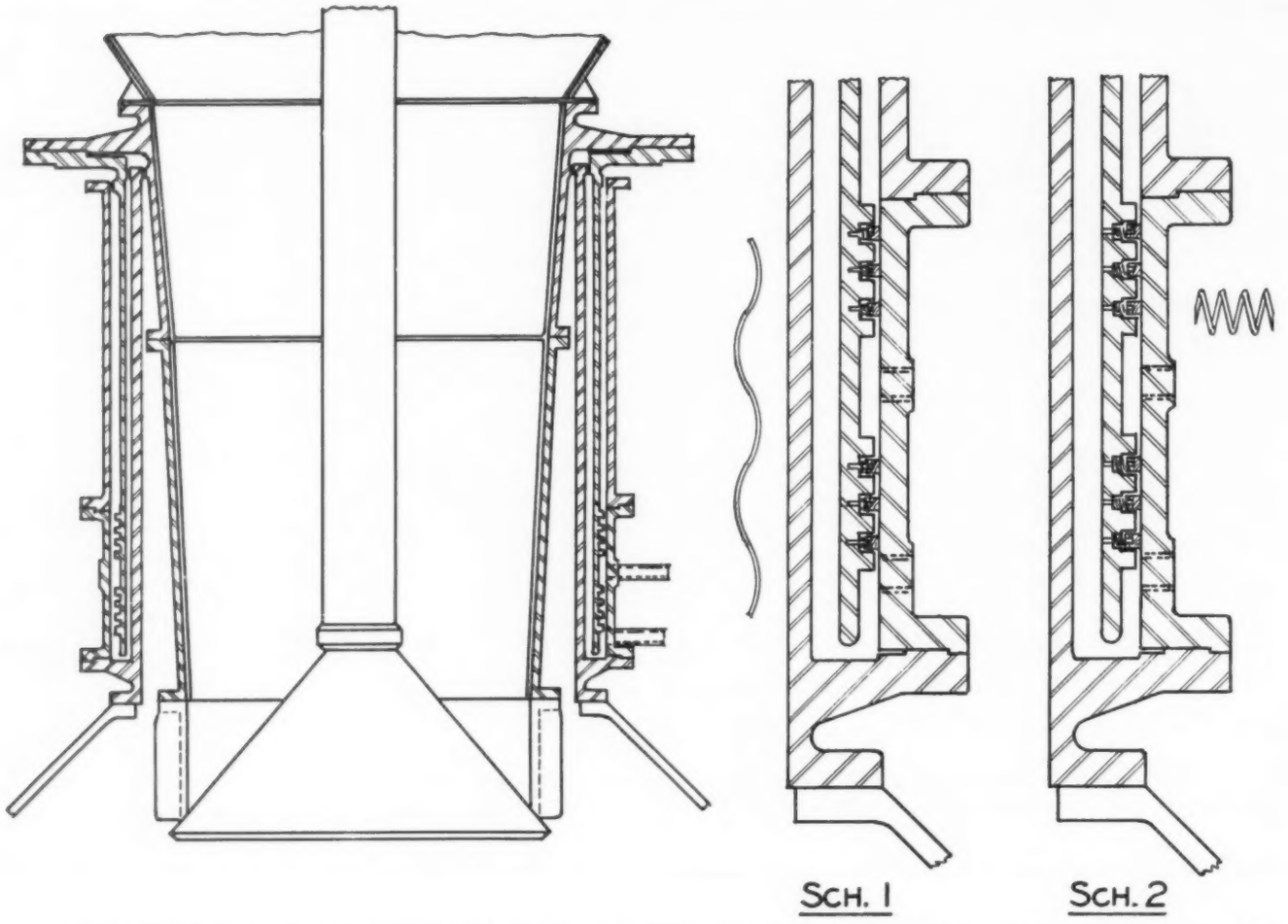


Figure 2 — Water seal has six laminated plastic rings in grooves which are machined in the rotating elements of the water seal.

ising solution seemed to be the seal which has come to be known as the Interlake seal shown in Figure 4. This seal uses grooves in both the rotating inner and stationary outer wall of the seal, opposite each other and with a sectional ring wide enough to span across the space between the two castings.

Since the original distributor on the Erie furnace had grooves in the rotating sleeve, it was a relatively simple matter to replace the sections of the outer stationary sleeve with sections having grooves cast and machined to match the existing grooves. The next question was the kind of material best suited for the rings. The distributor had six grooves, three above and three below the grease connections, so it was decided that three materials would be tried simultaneously—bronze, laminated plastic and neoprene. Two rings of each material were made up and a ring of each installed above and below the grease connection. After the new type of seal was placed in operation, the septum valve was closed down to create a top pressure slightly over 5 psig, and during a week of operation at this pressure the seal held without any sign of gas leakage. At the end of six months of operation, the rings were inspected and it was found that the neoprene was in perfect condition, the bronze was worn down about $\frac{1}{64}$ in. in thickness and the laminated plastic about $\frac{1}{32}$ in. The next inspection was made after $1\frac{1}{2}$ years of operation and again the neoprene was found to be in perfect condition and additional wear on the micarta and bronze could only be determined with a micrometer. No further inspection of the rings has been made and the seal has now been in service $2\frac{1}{2}$ years. It should be noted that on the high-speed operation of a distributor, the average number of revolutions for each skip dump is at least five compared to one-fourth revolution on 6-point operation, or 20 times, so that $2\frac{1}{2}$ years of high speed is the equivalent of 50 years on 6-point.

A spinning top with a water seal was installed on "B" furnace at Chicago in December of 1951 and, since this plant operates with a 40 to 50-in. water column top pressure, the seal was continually being blown empty. In August of 1956, a venturi washer was installed on this furnace and, at the same time, it was equipped with a new distributor using the Interlake seal equipped with all rings of neoprene. During the blow-in the top temperature went up to about 950 F and there was some concern regarding damage to the neoprene rings. The seal was inspected in July, 1957 and the rings were found to be in excellent condition.

Right from the time of conception of the spinning top, there was considerable concern regarding the maintenance on the distributor. It is quite gratifying however that the maintenance has not been great. Toledo "A" furnace in $6\frac{1}{2}$ years has had six rollers replaced (this distributor is equipped with a total of twelve rollers; six support, three hold-down and three guide). One drive pinion has been replaced. Toledo "B" furnace in six years has had five rollers and one pinion replaced.

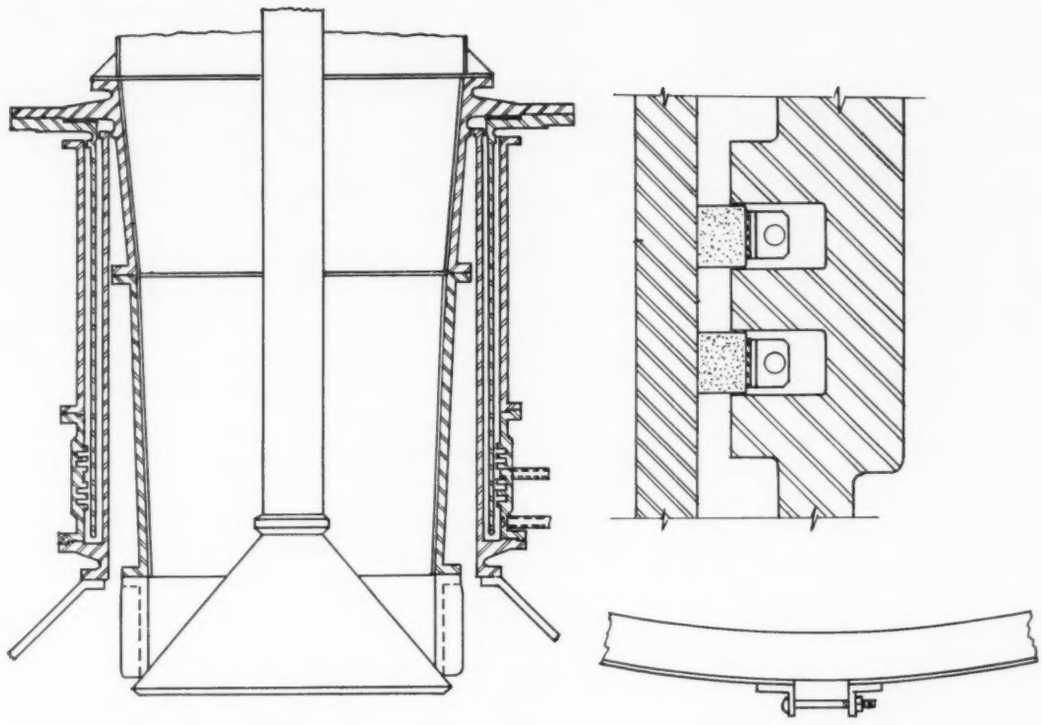


Figure 3 — This seal design was used on the new Chicago "A" furnace.

The Erie furnace in 4½ years has had one roller replaced and is still operating on the original pinion. The experience at the Chicago furnaces has not been good, but the cause of the trouble was due to the failure of the water seal. Each time the big bell dumped, the seal water was blown out and the rollers, bearings, track, ring gear and pinion were drenched with water and flue dust. The average life of a set of twelve rollers was from six to nine months and of a drive pinion, two to three years. These replacements have given no concern since they can be made without taking the wind off the furnace. The present distributor on Chicago "B" furnace with the new seal has been in operation a year with no replacements.

The old ball and race swivels on the Toledo furnaces proved unsatisfactory but they were soon replaced with a new roller type. These last about four years and, since their replacement requires a rather lengthy shutdown, their life should be improved. One of the well known bearing manufacturers has studied the problem, and recommended a double roller swivel which is presently on order and it is hoped that this new swivel will give much better service.

Shortly after the high-speed top was put in use, everyone hoped that the better distribution would increase the furnace lining life. This has now been established beyond all expectations. The production of merchant iron is extremely hard on linings. This is evidenced by

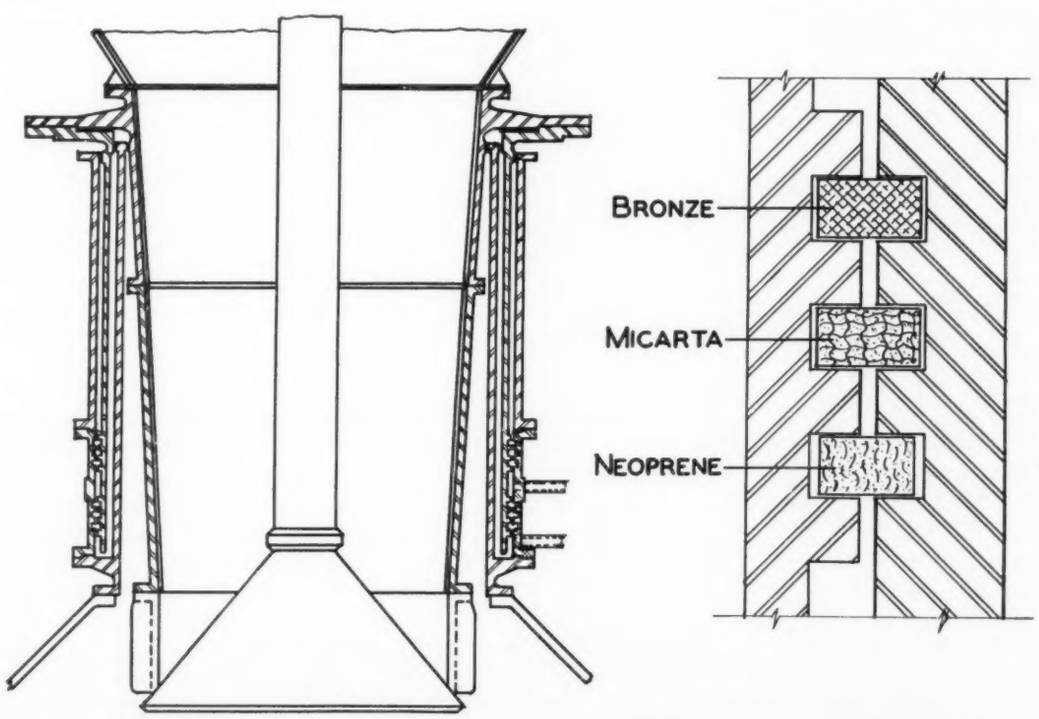


Figure 4 — This design is known as the Interlake seal.

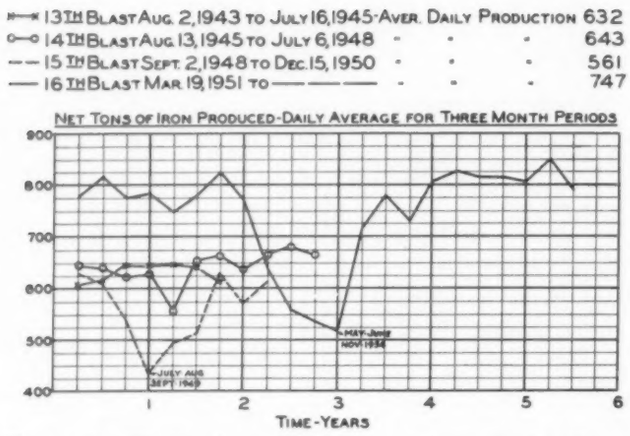

13TH BLAST AUG. 2, 1943 TO JULY 16, 1945 - AVER. DAILY PRODUCTION 632
14TH BLAST AUG. 13, 1945 TO JULY 6, 1948 643
15TH BLAST SEPT. 2, 1948 TO DEC. 15, 1950 561
16TH BLAST MAR. 19, 1951 TO 747
NET TONS OF IRON PRODUCED - DAILY AVERAGE FOR THREE MONTH PERIODS
TIME-YEARS

Figure 5 — Chart shows net tons of iron produced on Toledo "A" furnace.

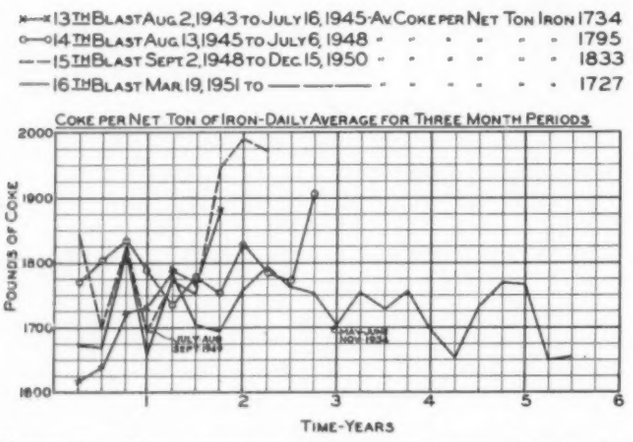

13TH BLAST AUG. 2, 1943 TO JULY 16, 1945 - AV. COKE PER NET TON IRON 1734
14TH BLAST AUG. 13, 1945 TO JULY 6, 1948 1795
15TH BLAST SEPT. 2, 1948 TO DEC. 15, 1950 1833
16TH BLAST MAR. 19, 1951 TO 1727
COKE PER NET TON OF IRON - DAILY AVERAGE FOR THREE MONTH PERIODS
POUNDS OF COKE
TIME-YEARS

Figure 6 — Chart shows coke consumption on Toledo "A" furnace.

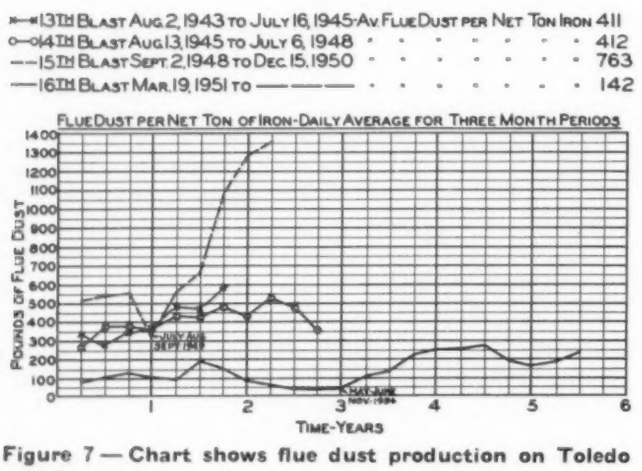

13TH BLAST AUG. 2, 1943 TO JULY 16, 1945 - AV. FLUE DUST PER NET TON IRON 411
14TH BLAST AUG. 13, 1945 TO JULY 6, 1948 412
15TH BLAST SEPT. 2, 1948 TO DEC. 15, 1950 763
16TH BLAST MAR. 19, 1951 TO 142
FLUE DUST PER NET TON OF IRON - DAILY AVERAGE FOR THREE MONTH PERIODS
POUNDS OF FLUE DUST
TIME-YEARS

Figure 7 — Chart shows flue dust production on Toledo "A" furnace.

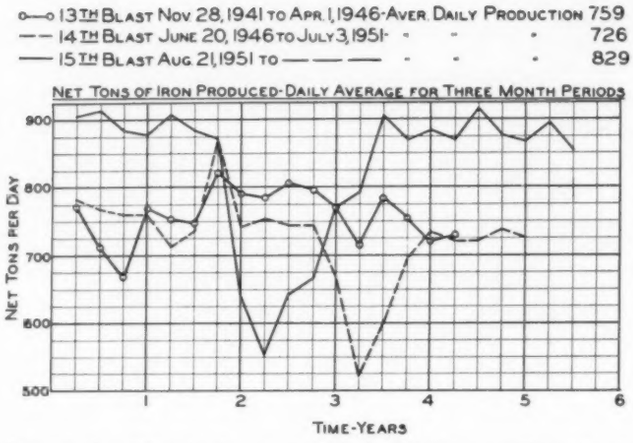

13TH BLAST NOV. 28, 1941 TO APR. 1, 1946 - AVER. DAILY PRODUCTION 759
14TH BLAST JUNE 20, 1946 TO JULY 3, 1951 726
15TH BLAST AUG. 21, 1951 TO 829
NET TONS OF IRON PRODUCED - DAILY AVERAGE FOR THREE MONTH PERIODS
NET TONS PER DAY
TIME-YEARS

Figure 8 — Chart shows net tons of iron produced on Toledo "B" furnace.

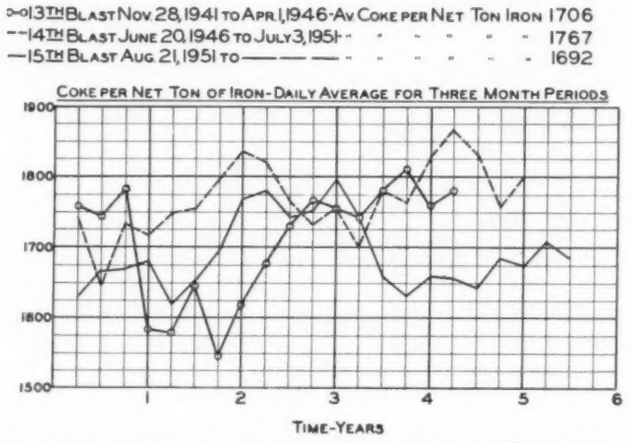

13TH BLAST NOV. 28, 1941 TO APR. 1, 1946 - AV. COKE PER NET TON IRON 1706
14TH BLAST JUNE 20, 1946 TO JULY 3, 1951 1767
15TH BLAST AUG. 21, 1951 TO 1692
COKE PER NET TON OF IRON - DAILY AVERAGE FOR THREE MONTH PERIODS
TIME-YEARS

Figure 9 — Chart shows coke consumption on Toledo "B" furnace.

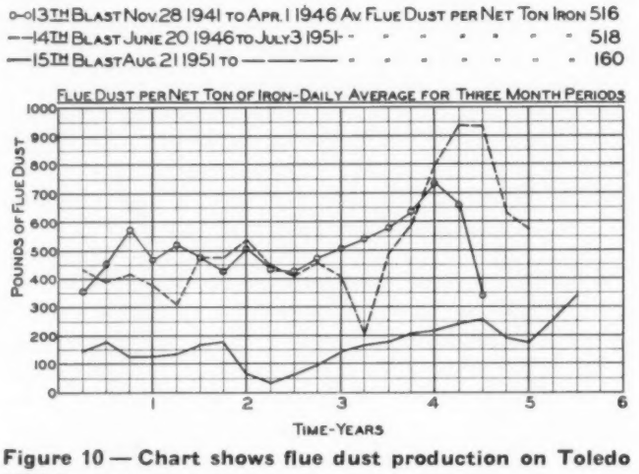

13TH BLAST NOV. 28 1941 TO APR. 1 1946 AV. FLUE DUST PER NET TON IRON 516
14TH BLAST JUNE 20 1946 TO JULY 3 1951 518
15TH BLAST AUG. 21 1951 TO 160
FLUE DUST PER NET TON OF IRON - DAILY AVERAGE FOR THREE MONTH PERIODS
POUNDS OF FLUE DUST
TIME-YEARS

Figure 10 — Chart shows flue dust production on Toledo "B" furnace.

the fact that hot spots developed in the Interlake furnaces and water was sprayed on the shell after about two years service on an inwall, but at the present time there is no evidence of hot spots. With 6½ years on Toledo "A," six years on Toledo "B," 4½ on Erie, four on Chicago "A" and three years on Duluth, and no water on the shell on any of these furnaces, it is quite evident that the lining life has been very appreciably increased. Chicago "B" furnace showed definitely that in nearly five years there had been no channeling of the lining. In August, 1956, it was taken out of blast after four years and eight months service to install a venturi washer in order to obtain better gas for underfiring the new batteries of coke ovens at this plant. It was deemed wise to clean the furnace out and inspect the inwall during the shutdown. Inspection revealed that the lining was worn back about 18 in. and the wear was uniform circumferentially. At the time this furnace was taken out, the linings on the two Toledo furnaces had seen over five years of service and, although it was quite apparent that the lining in the furnace was good for additional service, it was quite possible that three furnaces

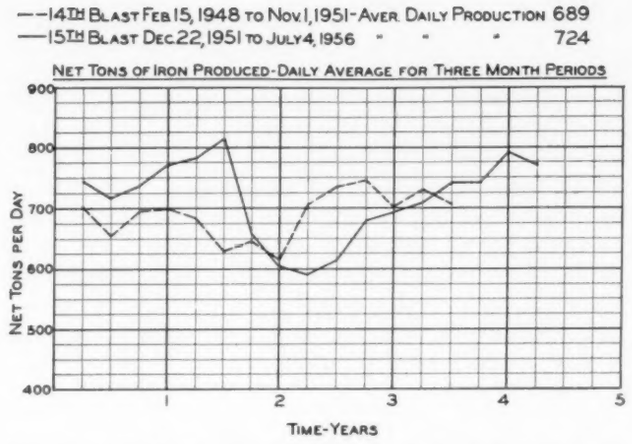


Figure 11 — Chart shows net tons of iron produced on Federal "B" furnace.

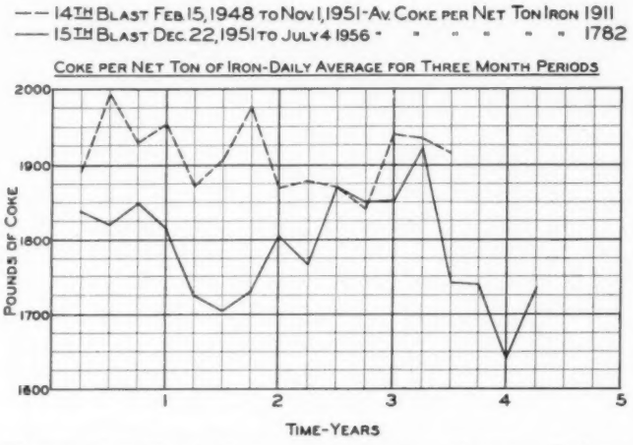

— — 14TH BLAST FEB 15, 1948 TO NOV 1, 1951 - AV. COKE PER NET TON IRON 1911
— 15TH BLAST DEC. 22, 1951 TO JULY 4 1956 " " " " " " 1782
COKE PER NET TON OF IRON - DAILY AVERAGE FOR THREE MONTH PERIODS
POUNDS OF COKE
2000
1900
1800
1700
1600
1
2
3
4
5
TIME - YEARS

Figure 12 — Chart shows coke consumption on Federal "B" furnace.

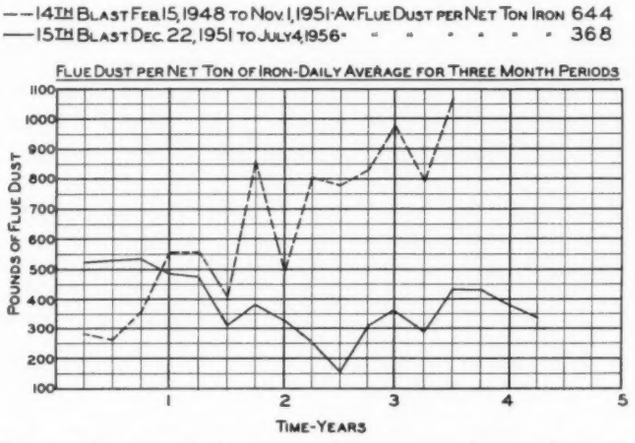


Figure 13 — Chart shows flue dust production on Federal "B" furnace.

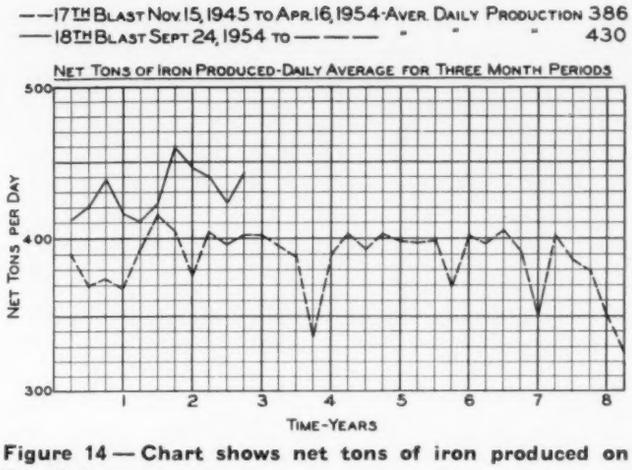


Figure 14 — Chart shows net tons of iron produced on Zenith furnace.

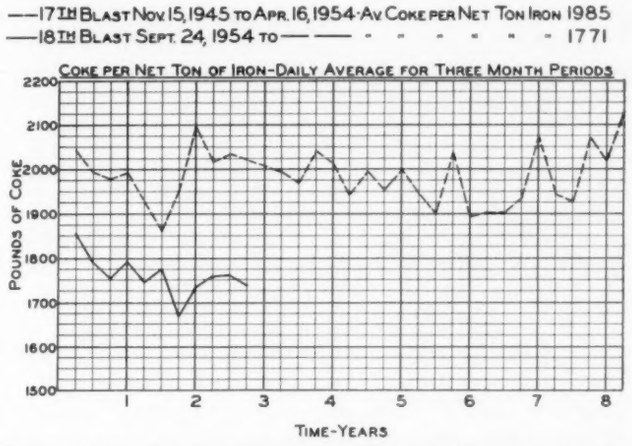


Figure 15 — Chart shows coke consumption on Zenith furnace.

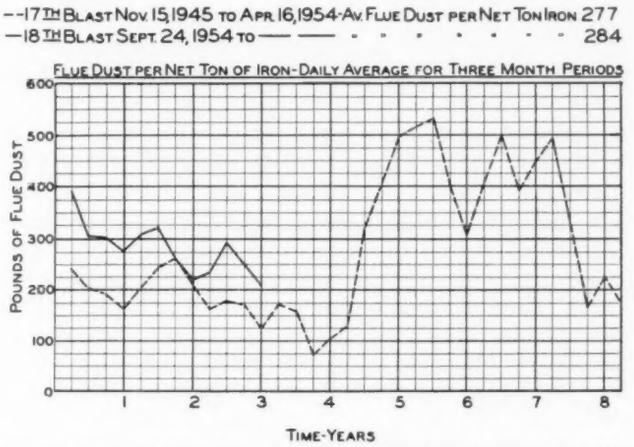


Figure 16 — Chart shows flue dust production on Zenith furnace.

would need new linings at the same time. The installation of the new gas washer, the changes to gas piping, and the replacement of the water sealed distributor required about three weeks of furnace downtime, so it was evident that, since the new inwall lining brick was available immediately, the wise move would be to reline from the mantel up simultaneously with the previously planned changes.

Speaking of repairs and lining life, the spinning top has made a radical change in thinking in the Interlake organization. Before installation of the spinning top, four years was considered a normal campaign on a merchant furnace, with many lasting only two or three. Now with both furnaces at Toledo in their seventh year, and on higher production rates than ever before, nearly everything is showing signs of needing heavier construction; uptakes, downcomers, hot blast mains and even the large bell wore through on Toledo "A" recently.

The power requirements for high-speed operation are not as great as might be expected. The motors for all the different seals mentioned previously are 30-hp, compound-wound, mill type with the exception of the gland

type seal at Duluth which was equipped with a 50-hp motor of the same type. The 30-hp motors have given no trouble whatsoever on any of the distributors. The gland type seal proved to be unsatisfactory due to the excessive wear on the packing. It was practically impossible to keep the gland tight enough to hold the grease consumption to a nominal figure, and at the same time prevent the overloading of the 50-hp motor.

The amount of grease used on the Interlake seal varies from two to three pounds per day at Erie to about 30 lb at Chicago. An automatic grease injection system is used at both plants, and the number of shots injected during each skip can be varied as deemed necessary.

Graphs have been prepared to show the daily average for each period of three months during various campaigns; of pig iron produced in net tons, coke consumed in pounds per net ton of iron and total flue dust (dry plus wet) produced in pounds per net ton of iron covering the operation of the six furnaces using the high-speed distributor. It should be borne in mind that the operating figures are on merchant furnaces, which produce iron having an average silicon content of 2 per cent with many grades containing 3¼ per cent and that the tonnage produced, coke consumed and flue dust production cannot be compared with steel plant furnaces producing iron averaging about 1 per cent silicon. Furthermore, these merchant furnaces are not producing the same grade of iron month in and month out. The iron produced by a single furnace will vary in silicon content from one week to the next by as much as 2 per cent and the changes in burden and temperature have a detrimental effect on the operating figures and on the lining life. For the furnaces where the hearth diameter was the same on previous blasts, the charts show the comparison of the operating figures using the 6-point and the high-speed distributor. The Chicago "A" furnace and Perry furnace were completely rebuilt and enlarged at the time of installing high-speed operation and comparisons are not possible.

Figure 5 shows the net tons of iron produced on Toledo "A" furnace during three campaigns with 6-point operation and the present campaign with high speed. The curve for the high-speed top period shows a very marked increase over the 6-point periods. The outstanding thing shown in this chart is the length of the campaign. The production after six years of operation on the brick lining is still high and even higher than at any time during the campaign. The other three campaigns, the 13th, 14th and 15th blasts covered only 1¾ years, 2¾ years and 2¼ years respectively, compared to 5½ years on the 16th blast with the end not yet in sight. The average production for the 16th blast on high-speed operation of 747 net tons is quite an increase over the previous blasts, but if the recession period in 1953 to 1954 had not occurred and the furnace pushed to its capacity, as was the case during the 13th and 14th blasts, the war period, the increase would have been still better.

An explanation of the time covered by this, and all other charts referred to further along, should be made at this time. The points for the curves are plotted for each 3-month period, and the 5½ years of curve represent full months of operation. All blow-in and blow-out fractional months and all full months of downtime are omitted. An example of this shows on the 16th blast on this chart at the 3-year point of the curve. A recession in business occurred in 1954, and production was cut to the point where it was decided to bank this furnace in July and to put it back in operation in October. The point on the curve, therefore, at 3 years represents the production for the months of May, June and November, the part months of July and October and the full months of August and September were not used in the averages. The other low point on this chart occurs at the one-year mark of the 15th blast. This was another low point in the 1949 recession, but the furnace was not banked and the average covers the consecutive months of July, August and September.

Figure 6 covers the coke consumption during the same four campaigns on the Toledo "A" furnace. This chart shows very clearly why the three earlier campaigns were of such short duration—when the coke rate goes up sharply for a period of three months, it is time to take a look at the inwall. At the end of 5½ years of the present campaign with the spinning top, the coke rate is still good and there is no hot spot to indicate how much longer the lining will last.

Figure 7 shows the flue dust production per net ton of iron during the four campaigns on the Toledo "A" furnace. These figures include both the dry or dust-catcher dust and the wet dust from the thickener. The dry dust weight is obtained by actually weighing the flue dust car every morning and therefore is not an estimate. The weight of the dust recovered by the thickener is calculated from increment quantities obtained hourly from the filter cake conveyor and the proper factors applied to obtain the total for 24 hr. The dust rate with the spinning top has been and still is considerably better than on the 6-point campaigns.

Figure 8 shows the net tons of iron produced on the Toledo "B" furnace during two campaigns with 6-point operation and the present campaign with high speed. The curve for the present campaign, 15th blast, is considerably higher than the previous campaigns. The low peak occurs at the 2¼ point which is the recession in 1954. This furnace was not banked, however. Here again had it not been for this recession in business, the average of 829 net tons would have been higher if the furnace had been pushed to maximum capacity as was the case during the 13th blast, the war period. The low point on the curve for the 14th blast is due to the 1949 recession. The length of the present campaign has not exceeded the previous campaigns to such an extent as was the case on "A" furnace. However, water was sprayed on the shell of the furnace during the greater part of each campaign prior to and including the 14th blast, but up to the present time during the 15th blast, no water has been used on the shell and there is no indication of a hot spot.

Figure 9 shows the coke consumption during the same three campaigns on this Toledo "B" furnace. The improvement in the rate of coke consumption with the high speed top compared with 6-point operation for this furnace is not as great as on the Toledo "A" furnace, but the decrease in rate is sufficient to indicate that the distribution of stock has improved this phase of the operation.

Figure 10 shows the flue dust production for the three campaigns on the same Toledo "B" furnace. The production of dust on high-speed operation even though it has increased during the past 6 months, is still far below

the average for the previous campaigns on 6-point operation.

Figure 11 shows the net tons of iron produced on the Chicago "B" furnace during the 14th blast with the 6-point distributor and during the 15th blast with the spinning top. This furnace was and still is a single skip furnace and, as pointed out before, the distribution with a single skip is more uniform using a 6-point top since the peak of the stock as it rests in the revolving hopper always has the same orientation, directly under the lip of the skip car. When the top is then rotated through the 6-point program, these peaks are distributed regularly in the furnace. This type of distribution, however, does not produce the even distribution as obtained when there are no peaks to start with. This is reflected in the production curves of this furnace when compared with the curves of the Toledo furnaces, in that, the production increase gained in using the high-speed distributor on the single skip furnace is not as great as it is for the double skip furnaces but it is still appreciable. Again it is to be noted that the 14th blast lining lasted $3\frac{1}{2}$ years with the 6-point top, whereas the 15th blast with the spinning top was still operating at the end of 5 years, when the furnace was blown out for the installation of the new gas washer, and still at a rate of production as high as ever experienced during the campaign.

An interesting factor in loading the revolving hopper while it is spinning became apparent in this installation. A single skip furnace needs no receiving hopper to funnel the material into the revolving hopper so the skip dumped directly into the revolving hopper on this furnace. For the first nine months it was realized that the distribution was not good in the spinning hopper, a peak existed which was almost as high as that resulting from the skip dumping into a stationary hopper. The only difference between this installation and those on the Toledo furnaces was the absence of a receiving hopper which apparently slowed down the dumping time at Toledo. Several schemes for retarding the dump were suggested, and it was decided to try the easiest method, the installation of a stationary plate 24 in. beyond the lip of the skip when in its dumping position. This was the answer to the problem; the retarding plate is still in use and the stock levels off in good shape. The installation of this plate is reflected in the ascent of the curve for the 15th blast at the 1-year point of the chart. The dip in the curve at the 2-year point is due to the 1953–54 recession.

Figure 12 is the chart showing the coke consumption during these two campaigns on the Chicago "B" furnace. The curve of the coke consumption during the 15th blast with the high speed top is well below the one for the blast using the 6-point distributor. Also, the rate at the end of five years is still excellent for merchant iron production. It is also evident that the installation of the retarding plate is reflected at the one-year point of the curve for the 15th blast.

Figure 13 shows the curves on the flue dust during these two campaigns. The dust rate is considerably lower during the campaign with the spinning top, the rate was still excellent at the end of five years and the use of the retarding plate is evident after the one-year point of the curve.

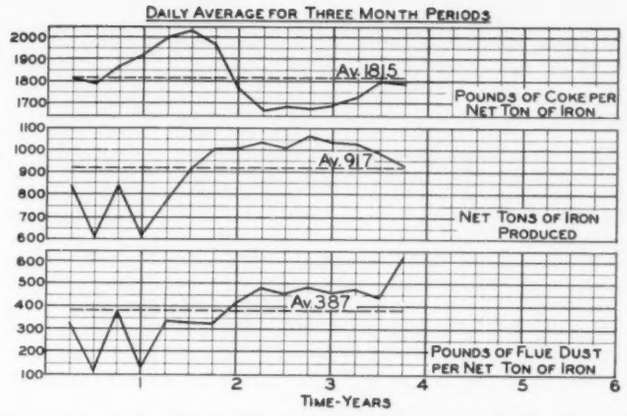

DAILY AVERAGE FOR THREE MONTH PERIODS
Av. 1815
POUNDS OF COKE PER NET TON OF IRON
Av. 917
NET TONS OF IRON PRODUCED
Av. 387
POUNDS OF FLUE DUST PER NET TON OF IRON
TIME-YEARS

Figure 17 — Chart gives operating data on Federal "A" furnace which went into its first blast on September 1, 1953.

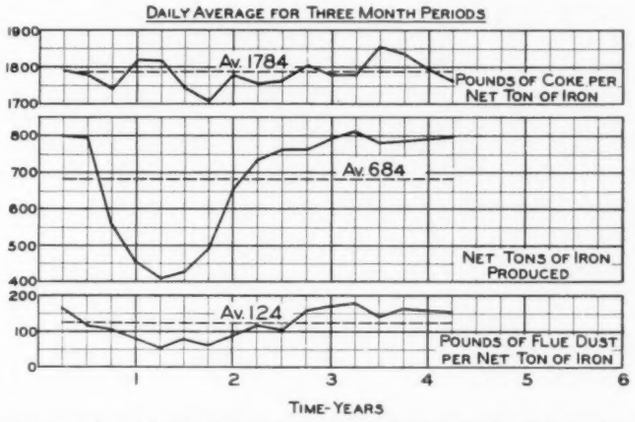

DAILY AVERAGE FOR THREE MONTH PERIODS
Av. 1784
POUNDS OF COKE PER NET TON OF IRON
Av. 684
NET TONS OF IRON PRODUCED
Av. 124
POUNDS OF FLUE DUST PER NET TON OF IRON
TIME-YEARS

Figure 18 — Chart gives operating data on Perry furnace which went into its first blast on March 4, 1953.

The present campaign on this Chicago "B" furnace started in mid-August 1956 and, since there would only be three 3-months points on a curve for this 16th blast, no curve has been plotted. The operating averages for the 11 full months of operation (omitting the month of August, 1956, and including July, 1957) are as follows:

Net tons of iron produced per day	771
Pounds of coke per net ton	1746
Pounds of flue dust per net ton	297

Figure 14 shows the curves for the iron produced on the 17th blast using the 6-point distributor and the 18th blast using the high-speed top on the Zenith furnace at Duluth. The 17th blast was exceptionally long for any of the Interlake furnaces, so from a standpoint of lining life comparison the curves are meaningless. The present lining may or may not last as long as the previous lining, but it should be pointed out that the lining for the 17th blast was in very poor shape for the last four or five years of the campaign. The chart does, however, show that the production rate has improved with the spinning top.

Figure 15 is a chart showing the coke rate on the Zenith furnace for the 17th and 18th blasts and considerable improvement is shown during the 18th blast using the high-speed top compared with the 17th blast with a 6-point distributor.

Figure 16 shows the flue dust production for the same two blasts on the Zenith furnace. There can be no com-

parison made of the relative flue dust production on this furnace between the 6-point and high-speed distributors. During the 17th blast on the 6-point unit, the furnace had a very inefficient dustcatcher. It was a very short unit with the downcomers entering near the top of the bottom cone and the inlet gas stream was directed down toward the cone. This all adds up to a dustcatcher that did not retain any of the lighter dust, and it was estimated that 75 per cent or more was left in the exit gas to be removed by the gas washer. Furthermore there was no thickener at this plant until April, 1950, and the dust figures for the first five years of the campaign included no filter cake, only the dry dust production. The latter years of the campaign include both the wet and dry dust and this accounts for the sharp increase during the 5th year of the blast.

The Chicago "A" furnace is a new and larger unit built in 1953 on the site of the old small furnace. There are, therefore, no previous operation records to use for comparison on this stack. Figure 17 is a combined chart with the pig iron production curve in the center, the coke consumption curve above and the flue dust production curve below. It is interesting to note how closely the valleys and peaks in the flue dust curve follow the valleys and peaks in the iron production curve.

The Perry furnace at Erie, Pennsylvania, is another case where there are no previous campaigns for comparison. This furnace also is a new and larger stack built to replace the older unit in 1953. Figure 18 is, again, a combined chart with the iron production curve in the center, the coke curve above and the dust curve below. Here again the flue dust curve follows the iron production curve generally. This furnace has the best dust production record of any in Interlake but, to some extent, this is due to the fact that it has not been pushed for production as hard as some of the others. It is a twin of the Toledo "B," but study of the production curves will show that when the market was good, Toledo "B" was producing around 900 tons per day while the Perry furnace was held to 800 tons or less.

Discussion

PRESENTED BY

MARTIN J. CONWAY, Consulting Engineer, Millersville, Pa.

Martin J. Conway: The author's honest discussion of the initial mechanical improvements which became apparent, and presentation in reference form of the results obtained, before and after installation of the revolving hopper, are data well worth careful study.

Interpretation of these data applied to average blast furnace operation, regardless of cost difference in furnace burdens, point to a definite saving in over-all cost of operation per ton of iron produced, and while the author makes no specific claims, it seems to me that at least $1.00 per ton of iron cost saving can be readily realized, all features considered, and an item of this magnitude cannot be lightly dismissed, especially so when it is realized without affecting burden cost. ▲

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Jerome L. Lindberg
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Utah

by W. J. TUNNY, Superintendent, Electrical Maintenance Youngstown Sheet and Tube Co., East Chicago, Ind.

Dual Bridge Drives for Overhead Traveling Cranes

. . . . a crane with a properly constructed bridge provides an ideal arrangement for dual drives, particularly in high tonnage cranes . . . .

THE development of dual drives for overhead traveling cranes required careful consideration before proceeding with their design.

The first experience of one crane manufacturer of dual bridge drives without line shafts was a 350-ton gantry crane used on a spillway dam for lifting gates. The power supply was 440-volts, 3-phase, 60-cycle.

The total number of track wheels was sixteen, each having 33-in. tread diam. The number of driven wheels was eight, operated through a gear ratio of 99 to 1 with four 30-hp motors. Two track wheels were driven in each truck with an idler gear located between the two gears.

The complete drive, which includes the gears, pinion, motor and brake, were all mounted directly on the truck unit. This type of drive for this particular crane has four trucks with gear drives, four motor mountings and four trucks of idlers. The over-all length of one set of trucks plus the equalizer is 17 ft-3 in.

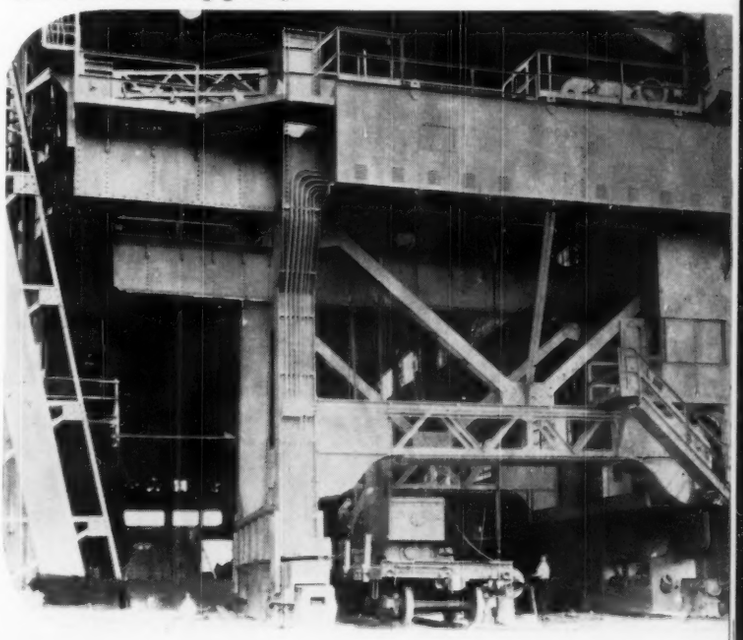
Their second experience with cranes that were driven without line shafts, was with a 225-ton ladle handling gantry (see Figure 1) on a track center of 34 ft-0 in. This crane was provided with a 15 ft-0 in. cantilever on the furnace end, only. The power supply was 230-volt, d-c. It had four 45-hp motors shunt-wound with a motor speed of 570 rpm. The bridge travel speed was 112 rpm.

The fourth experience in connection with cranes having no bridge line shaft was a 30-gross ton, 85 ft-0 in. radius revolving jib tower traveling crane, maximum lift at this radius is 110 ft-0 in. above rail and 10 ft-0 in. below rail, making a total of 120 ft-0 in. hook travel. Maximum height of crane is 169 ft-0 in. Power supply is 230-volt d-c.

The sixth experience with cranes not having bridge line shafts was with a 20-ton storage yard gantry crane (see Figure 2) with 5-ton auxiliary hoist, 40 ft-0 in. track span, 26-ft cantilever on one end, and 42 ft cantilever on opposite end. There are four 100-hp motors, series-wound, two motors on each side wired in series, having a motor speed of 342 rpm, and gear ratio of 4.56 to 1. Travel speed is 500 rpm. The bridge travels on double tracks, the rails having 24-in. centers. The track wheels are single flange, four wheels in each truck; two wheels on each axle.

After that the crane builder was confident that electric cranes could be operated very satisfactorily without line shafts for equalizing the drives. Approximately 13 bridge motion dual-drive, electric overhead traveling cranes varying in capacity from 150 to 375 tons have been built within the years 1949 to 1956. An Ohio Steel plant was one of the first to accept an electric overhead traveling crane having dual drives. In 1949 they purchased a 300-ton, four-girder ladle crane with six 45-hp motors and 24 wheels, and a 150-ton four-girder ladle crane with four 45-hp motors and 16 wheels based on this design (see Figure 3). The assuring factor was that

Figure 1 — Second unit built without line shaft is this 225-ton ladle handling gantry.



these cranes would be nearly square in their ratio of span to wheel base.

They chose a drive that would be compact, easily changed, have good life and perform satisfactorily. It was decided to use a worm drive mounted on a specially designed support for the necessary motor and brake. The worm gear center is mounted on an extension of the track wheel axle. The housing which enclosed the worm gear and worm is integral with the support for the motor and brake. The end of the support which is opposite the worm gear is supported by a pin which extends through the support into the truck and is held in the truck with a nut. All of the drives of both cranes were designed to be identical and all of the bridge trucks, both drivers and idlers were identical. The bridge drives had compound-wound motors. Later, series motors were used. The motors were paired and each pair connected in series. All pairs were paralleled. Power is 230-volt, d-c, travel speed is 225 rpm.

In a design of this type, sturdy bridge construction is required. If the motors on one side lag, the motors on the other side will tend to drive both sides through the bridge. If the bridge were flimsy in construction, one side of it would tend to drive ahead of the other.

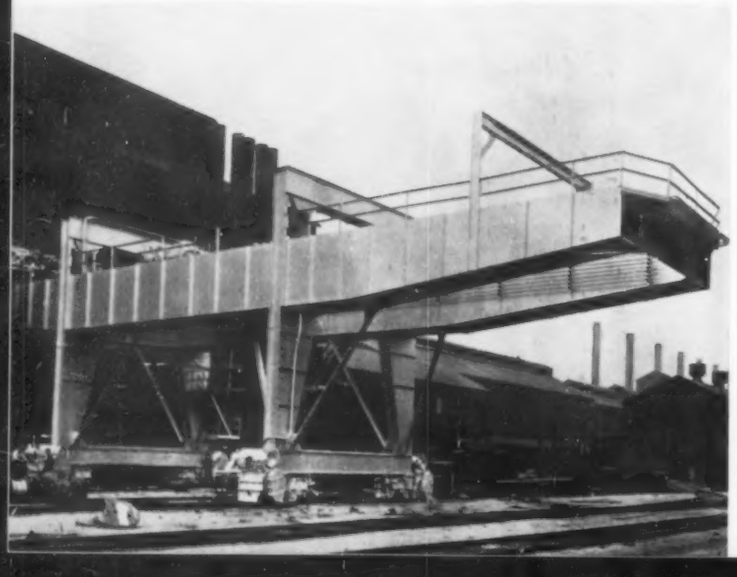
As an alternate to the worm drive, there are three ladle cranes in the Pittsburgh district using the spur gear drive. The cranes have 24 wheels, eight of which are driven and mounted on the four corners. Each motor and reduction drives two wheels. The crane, when originally constructed, had line shafts connecting the second reductions. This was because of the uncertainty of whether the crane would track properly when driven individually. The connecting line shafts were then removed. The drives consist of four 200-hp motors and they are paralleled.

This second method of driving the bridges has some advantages. Where six worm units are used, it is necessary that one be able to set the inside drives under a girder. This is not always possible, because of the lack of overhead clearance. Using the spur drive, one would be free to lower the girder mounting.

The worm drives allow clear footwalks and neatness of design. More work is required in changing driver track wheels. However, changing of the wheels is usually done not more often than from five to ten years.

When using worm drives, one must also be careful

Figure 2 — This 20-ton storage yard gantry has a 40-ft 0 in. track span and travels on double tracks with rails on 24-ft centers.



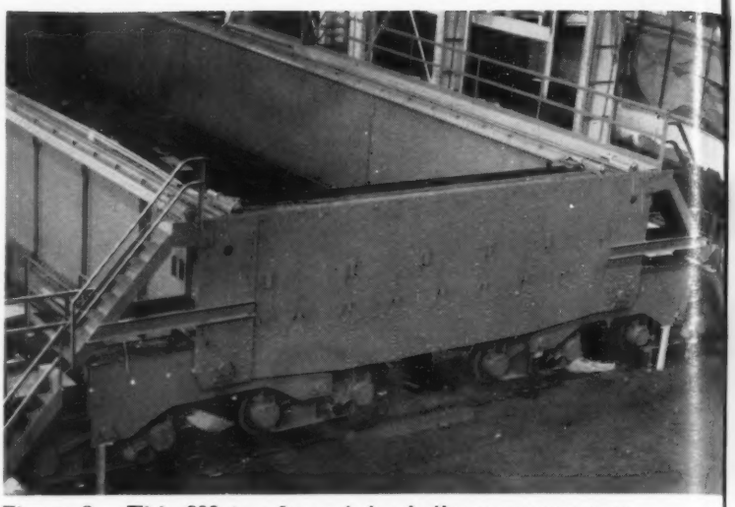


Figure 3 — This 300-ton four-girder ladle crane was one of the first electric overhead traveling cranes built without a line shaft.

not to hang the driving unit too low as jib hoists mounted at the furnaces below the runway girders may interfere with the drives.

The problem of properly designing the equalizers, pony trucks, and main trucks also presents a problem. They tend to use up end clearance between the centerline of the runway and the face of the building column. When these larger cranes are installed in new structures, allowance can be made, but when an existing runway is used, many times the end clearance is insufficient.

The Youngstown Sheet and Tube Co., Indiana Harbor Works, has three of these dual-driven cranes. They are ladle cranes with a dead weight of 1,500,000 lb, and a capacity of 350-tons or a total weight of 2,200,000 lb. There are 24 wheels, 30-in. tread diam having six 65-hp motors. The span is 76 ft-0 in. and travels at a speed of 180 fpm. The use of dual-drives represents a less costly crane because fewer shop hours are needed during floor assembly.

Figure 4 shows the layout of the six motors. It will be noted that the outside motors are cross connected in series and that the inside motors are connected in series. The pairs of motors are wired in parallel.

By having motors in series, it reduces the speed approximately one half, thus reducing the speed at the wheels without a high reduction in the gearing. Generally one reduction is sufficient.

Figure 5 shows one of the cranes during its assembly. Figure 6 is an arrangement showing two of the six drives for this type of crane.

The control board has three 2-pole motor switches so that any pair of motors may be cut out immediately. The space that is ordinarily used for line shafts is used for resistor boxes.

One pair of the three pair motors has a combination of solenoids and air brakes. The other two pair have air brakes only. The solenoid brakes are for parking or will set when power is off. The air pressure for the air brakes is about 38 psi. There is an individual air tank at each brake, and a main tank at the air compressor which is at the cab end of the crane.

The operation of these dual drive cranes is very smooth, in fact, you cannot hear the crane moving if you were to stand on the pouring platform directly

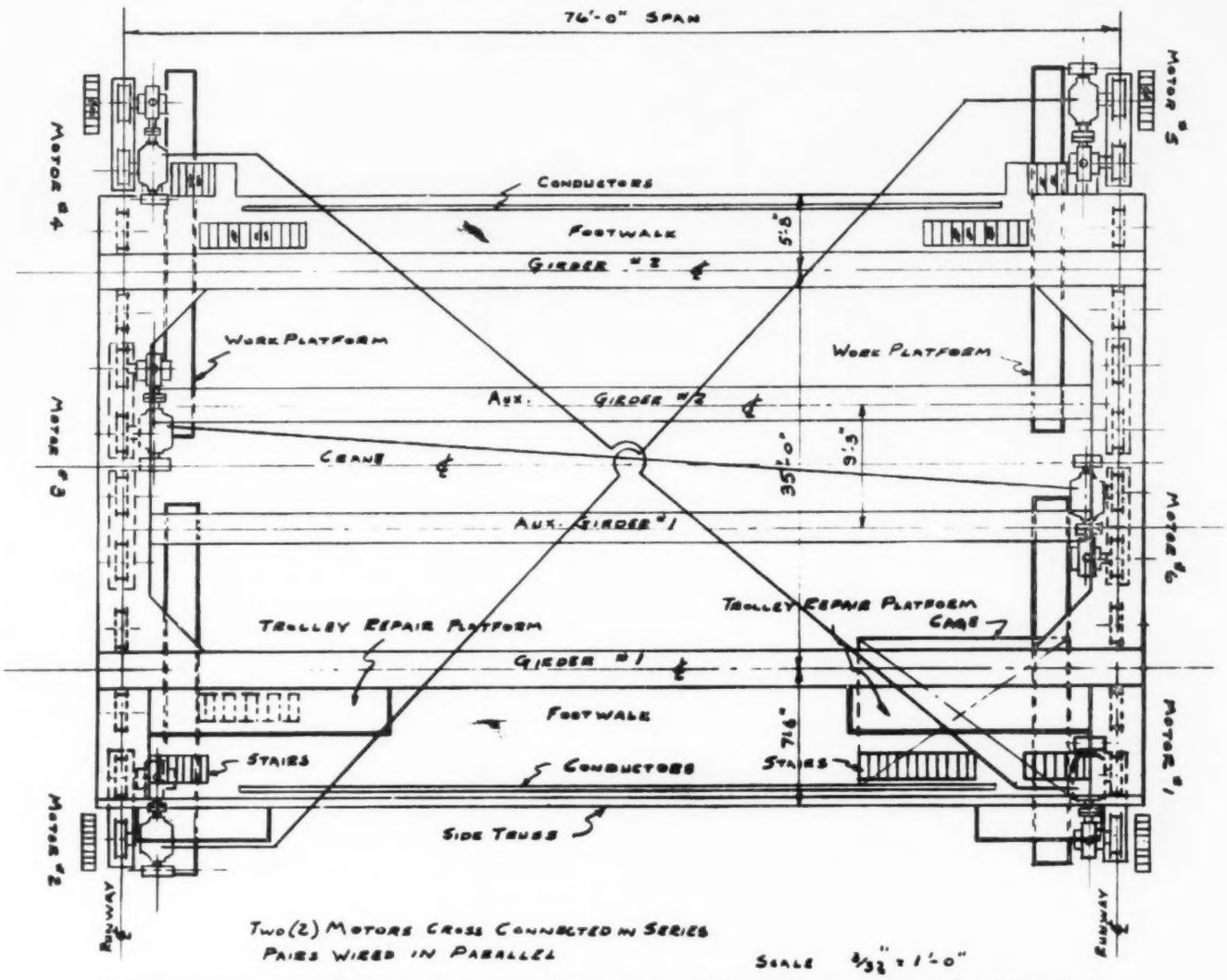


Figure 4 — Layout of 350-ton crane bridge with 76-ft span designed for operation without line shaft.

below. Some of the advantages of dual drives for bridge operation are as follows:

1. Eliminates maintenance of line shafts, bearings and its gearing.
2. Reduces overhang of walkway.
3. Eliminates the use of couplings, gears, pedestals and tie brackets.
4. Has smooth bridge operation.
5. Avoids greasy condition along walkway.
6. Reduces the size of motors required for bridge travel.

A crane with a properly constructed bridge will provide an ideal arrangement for dual drives, especially in the higher tonnage cranes. Now, ladle cranes are up to 500-ton capacity and may go still higher. Line shafts are gradually being eliminated. ▲

Figure 5 — Stiff construction in a crane is helpful for successful operation with dual drives.

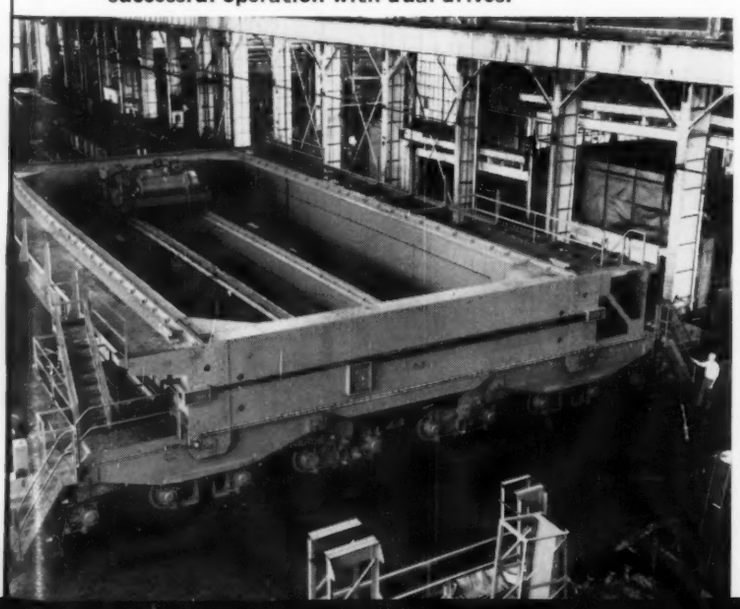
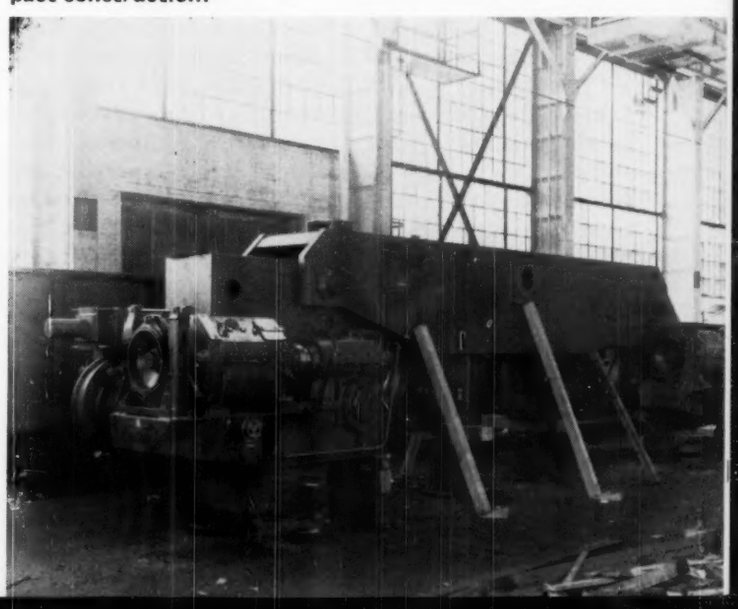


Figure 6 — Elimination of line shaft results in more compact construction.



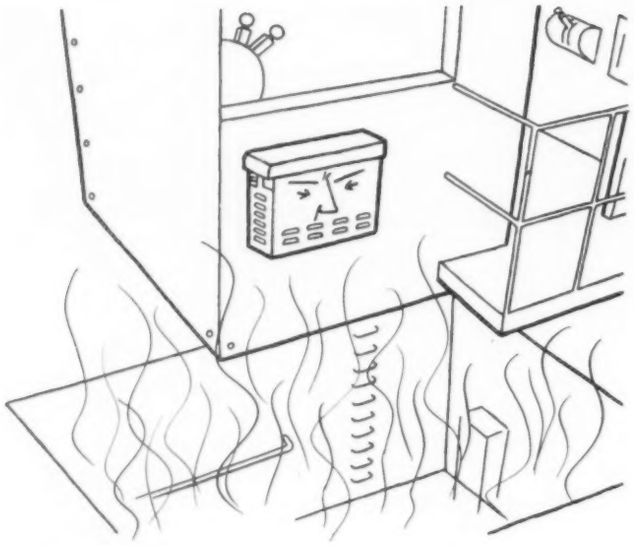


Figure 1 — Do not subject electronic equipment to extreme temperatures.

Proper Installation

THE iron and steel industry has for the past several years been investing in many different types of electronic systems.

The first electronics to enter the industry was communication equipment. Now this was very basic electronics and did not require a skilled technician for maintenance. So someone was given this responsibility as an added part to his primary job. Communication has since become very essential to all plant operations. Now there is a trend toward making this equipment a primary responsibility of some electrical maintenance man. It has taken many years to assume this position of importance.

All new electronic systems are falling into this same period of importance as did the communication system. Many complex electronic systems are now a part of the every day operation of the plant. One cannot wait for the maintenance to grow with these systems. One must provide a maintenance program at the time the new electronic equipment goes into operation.

Electronic maintenance will be divided into various categories as follows: installation, preventive maintenance, mill and shop maintenance.

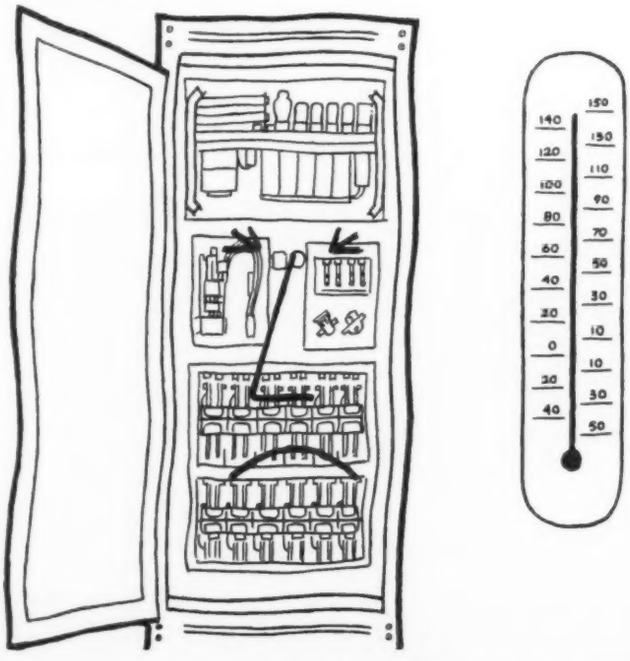
One may wonder why installation is included as part of maintenance. True, it is a distinct and separate operation, but if maintenance is to be of any value, a proper installation is of utmost importance. First of all, operating personnel and maintenance men must consult with suppliers for a recommendation as to the proper location for electronic controls. They cannot be located in whatever space remains after other equipment is installed. One must consider heat, vibration, dirt and nearness to the process being controlled. At the same time, the suppliers must realize the conditions that exist and design to meet these conditions. Electronic control has been spoken of "as that delicate equipment that you can hardly breathe on." This is true in one sense, but if it is designed and installed correctly, the electronic system will operate as well as any other electrical or mechanical system.

The next step is preventive maintenance. With any equipment one cannot wait until a failure occurs to think of maintenance. There are many things to do to increase the operating time of electronic control. Most equipment is designed so as to enable the exchange of various components and chassis so that they can be checked. In this manner, components that are losing their life can be changed before they fail. Dusting, cleaning, checking voltage regulation and sometimes lubrication are very essential to the life of electronic control.

Mill maintenance is on the job repair when the operation has stopped. It is then of primary importance to return to operations as soon as possible. This is no time to be concerned with the intricate details of electronic circuits. The men must be skilled and accurate diagnosticians. Here the manufacturers design, employing test panels, plug-in chassis and plug-in component cans is appreciated. The skilled serviceman can quickly remedy any trouble by the substitution method. All of our systems are designed using plug-in components and chassis.

The shop maintenance man must be the most skilled

Figure 2 — Electronic control systems suffer from high ambient temperatures.



by J. W. BAUER, Jr., Sales Manager, Femco, Inc., Irwin, Pa.

and Maintenance of Electric Control Systems

personnel. All spare equipment must be serviced and ready for use by the mill maintenance man. Necessary equipment, for accurate test, inspection and repair should be available. Shop personnel should be factory trained on the equipment that is installed in their plant. If this is done, the shop personnel will then become instructors for maintenance men in the various departments.

The following figures demonstrate how some electronic equipment is used in steel plants in connection with overhead crane operations.

Figure 1 shows a trolley phone communication unit mounted on the outside of a soaking pit crane cab. Now, space is definitely limited in this installation, but electronic equipment is not suited to the extreme heat coming from a soaking pit. In no time at all, the condensers would dry out and insulation on the wires would become brittle and break off. If a condition like this comes up, where the cab space is limited, it would be much better, after consulting the manufacturer, to use extension cables and mount the equipment above the cab where the heat problem would be considerably reduced.

The same heat problem is being shown in Figure 2. Figure 1 shows the effect of extreme heat for a short duration. Is that bad for electronic equipment? Yes, but high ambient temperature is equally harmful. In this case, all parts just melt and sag into a useless system. Ambient temperature problems are easily overcome if they are known. Forced air cooling or air conditioning will overcome all high ambients. Heaters will rectify the problem of condensation that accompanies sudden temperature changes. We are not trying to say that electronic systems will not function in normal steel plant temperatures, but definitely keep temperature as a consideration when proposing a location for new equipment.

. . . . proper installation is the key to electronic control . . . . maintenance will be correspondingly reduced and plant operation will be more economical . . . .

Another important consideration during the installation is the ease of operation. In many cases it appears that by adding additional controllers, selector switches, etc., in a crane cab, would make the crane operator look like our friend in Figure 3. This can easily happen, but by careful study, the operations may be simplified as shown in Figure 4.

Figure 3 — Crowded controls hinder crane operator.

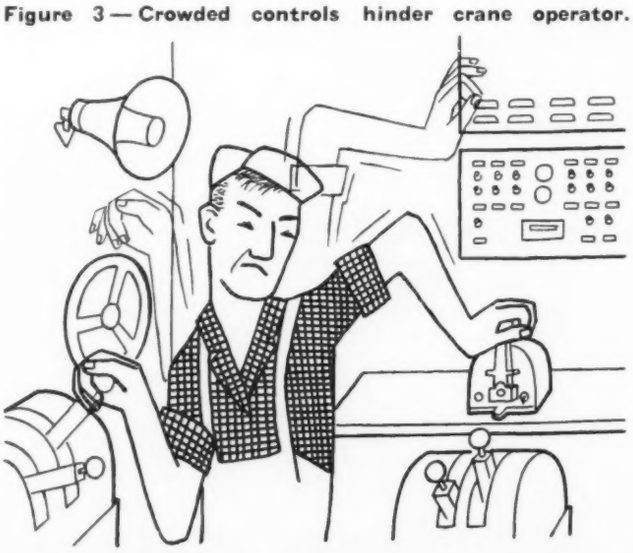
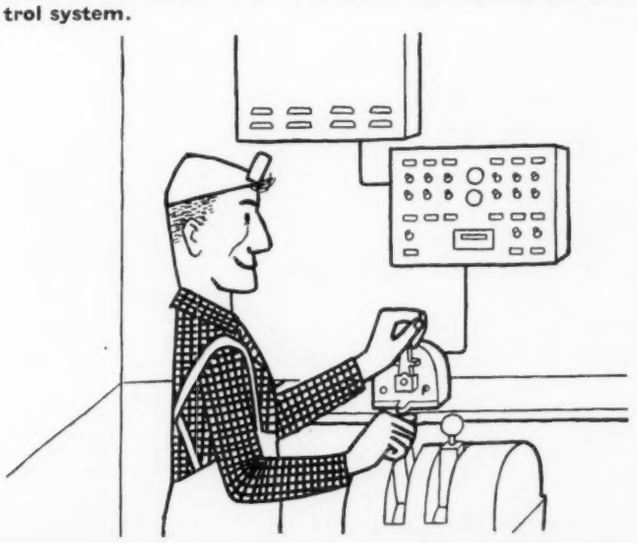


Figure 4 — Proper crane installation for soaking pit control system.



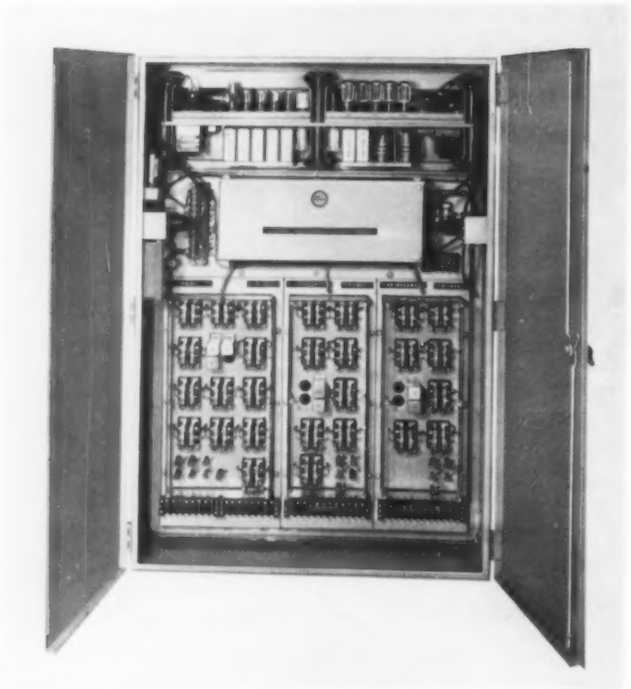


Figure 5 — Crane control system unit features plug-in components.

Of course this has been made overly simple. In the first place, the reaction is often, "I have never seen a crane cab so bare." That is true. The point is that the remote control system is only as good as its operator. Make the controls easy to operate and false operations and incorrect selections, etc., will be eliminated.

The following figures will show how the equipment has been designed so as to make maintenance as easy as possible. The unit shown in Figure 5 is a carrier shift receiver that is used to receive RF signal pulses from a carrier shift transmitter. This unit is the basic part of any control system that deals with moving cranes. Notice that this unit is shock mounted in all directions. It also fits into an outside housing for mechanical protection. A twistlock plug connector ties into the d-c power. All of the tubes are mounted on the top of the chassis so that the heat will rise and escape through

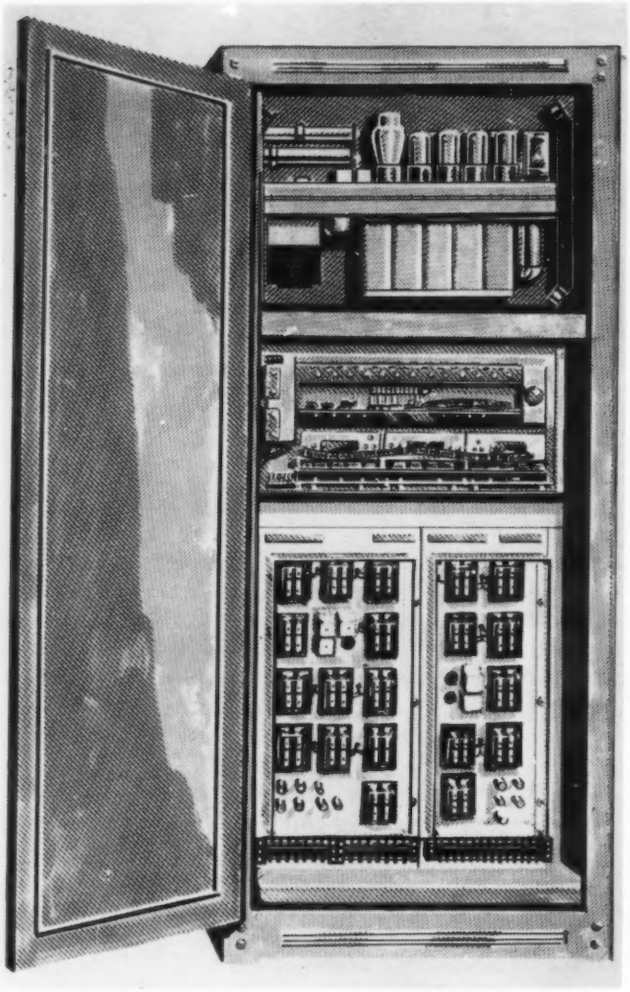


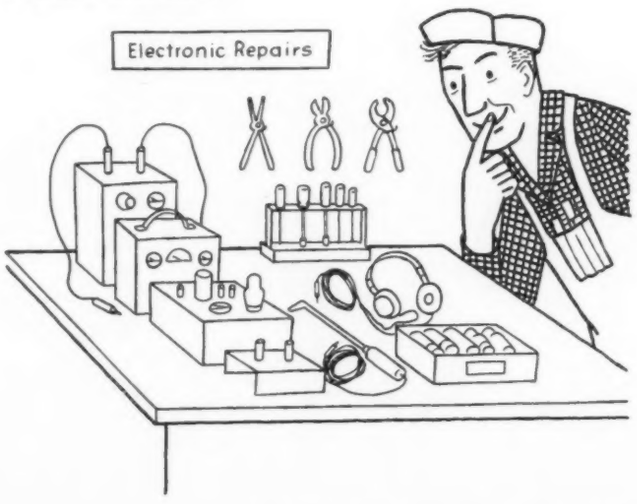
Figure 6 — Typical crane control unit is conveniently mounted.

vents in the top of the outside case. This design keeps all heat away from the component parts that are mounted in cans which plug in on the under side of the chassis. Plug in or packaged circuits are used in all practical cases.

Figure 6 shows a complete cabinet that would be mounted on a crane when the crane is controlled from the floor. The carrier shift receiver at the top, relay

Figure 7 — Untidy shop practices can lead to bench headaches.

Figure 8 — A good shop can keep any electronic control system functioning.



receiver next and the control relay panels at the bottom are all plug in connected to the cabinet. For quick maintenance when a crane is down, any unit can be removed and replaced with a spare unit in a very short time. Plug in units are identified by tags on each unit. By opening the doors all units are accessible. One does not have to get at the back of the cabinet at any time.

We hope that Figure 7 does not depict any operating electronic maintenance shop. To test and repair electronic units and components, a good work bench area is a necessity. In many plants, shops have been set up that would make a good many manufacturers sit up and take notice.

But the point is, as Figure 8 shows, a good shop will keep any electronic control systems functioning. Meters, test equipment, proper tools, etc., are required for electronics as they are for mechanical or electrical systems.

The following are some of the kinds of troubles one might expect with electronic control. Tubes are definitely the biggest possible source of trouble. But in all cases, the best available are selected for electronic control. Now transistors are finding their place as a substitute for tubes. All of this will help to keep maintenance at a minimum. Relays used in electronic control are the same as normal relay use, but here they are of a miniature version. Since the electronic relays only handle very small loads, they are as reliable as contactors in power circuits. The circuitry of electronic control should not be a maintenance factor. Wires, resistors, condensers and printed circuits are very reliable.

There is one other factor that should be mentioned at this time. Electronic control provides a means of getting all control signals on and off of moving cranes without adding any collector rails or wires. Only the two d-c power rails are required. Carrier current pulses are superimposed on the power system and then taken off at the control pulpit location. No sliding contacts, slip rings, etc., are used. This enables remote control features to be added to existing cranes at a very low installation cost. Existing facilities and new facilities are being improved. New facilities are also being designed with electronic control as a major factor to economic operations.

Everyone will agree that a proper installation is the key to electronic control. If the units are installed correctly, the maintenance will be decreased in the same proportion. One can then rely on having plant operation under the control of electronics. ▲

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Camera Shows Inside of Blast Furnace

HOW can you tell which one of two blast furnaces is in greater need of relining, when both of them are banked and the presence of gas prevents sending a man down for visual inspection of the brickwork?

For the first time in the history of the Pueblo plant—and possibly in the history of industrial photography—a camera solved the problem. Getting the pictures was a tricky job, and the many unusual factors put men and equipment to a severe test.

"A" and "E" were the two furnace units involved. Both furnaces were banked and both were due for relining, having each produced in excess of 1,200,000 tons of iron since last relined. There was, however, a possibility that one of the two furnaces might still be good for quite a few more casts. Blast furnace superintendent John Monson wanted pictures showing the condition of the stock line armor beneath the big bell section inside both furnaces.

The problems were intricate, as well as multiple. Devising a camera specially suited for the job was one of them. Then a proper synchronization system had to be worked out, and two containers, one to protect the camera against dust while it was operating, and another one to lower the instrument down the furnace, had to be built. Finally, they had to preset the shutter speed and the lens opening strictly by guess work.

The camera chosen was an old 4 x 5 Baca, a view model, on which was fitted a lens without built-in synchronization. The latter operated through a solenoid (a tubular coil acting as a magnet) mounted on the lens which triggers off the shutter when traversed by an electrical impulse. Next a box was fabricated of strong cardboard, leaving an opening in front for the lens and another one on top for the three-battery flash gun. It was then decided that setting off a No. 2 bulb in synchronization with the shutter would be the easiest method and would work better than if a strobe light, flood lights or an open flash were used.

During a subsequent session, the photographers thoroughly examined the engineering drawings of the furnaces, checking inside diameter and height of burden. The pictures to be taken had to be snapped at depths varying from 8 to 40 ft, in areas where the light was practically nonexistent. After calculations, it was decided to preset the camera for a focus of 15 ft and to use a lens opening of f.11 and a shutter speed of 0.01 sec. Film selected was Royal X Pan cut film, with an ASA rating of 250.

While the photographers were assembling their equipment and securing a 40-ft electrical extension cord, a strong wooden box was made that would protect the camera and its sealed cardboard containers as they were lowered by rope through the big bell opening and down the furnace. Within two days everything was ready.

Two hours were needed for the job, and eight pictures were taken. Each time the camera was lowered down the furnace, it was necessary to wait until the swinging motion

Figure 1 — The connections are taped to prevent them from becoming loose while equipment is lowered down furnace.

Figure 2 — Studio is violently illuminated as bulb on camera goes off during early try. Experiment was to test circuit and batteries.

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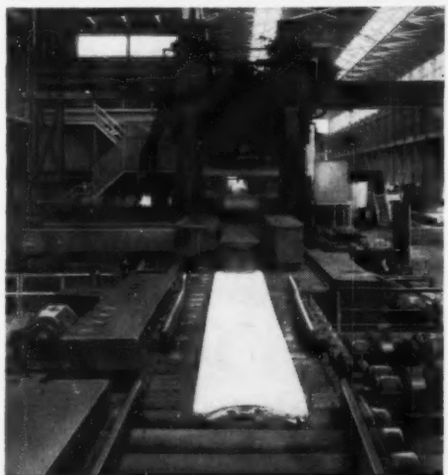

Blooming Mill Equipment erected by The Rust Engineering Co.

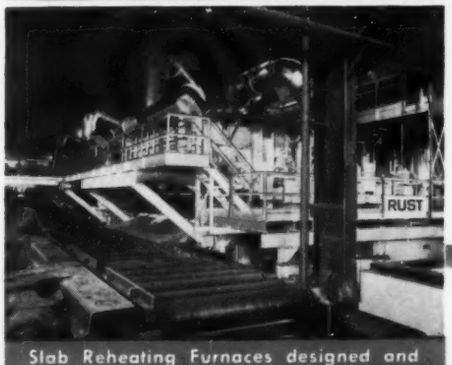

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Figure 3 — Lift containing photographic equipment makes 100-ft upward trip to platform. Walkway at right leads to furnace's big bell.

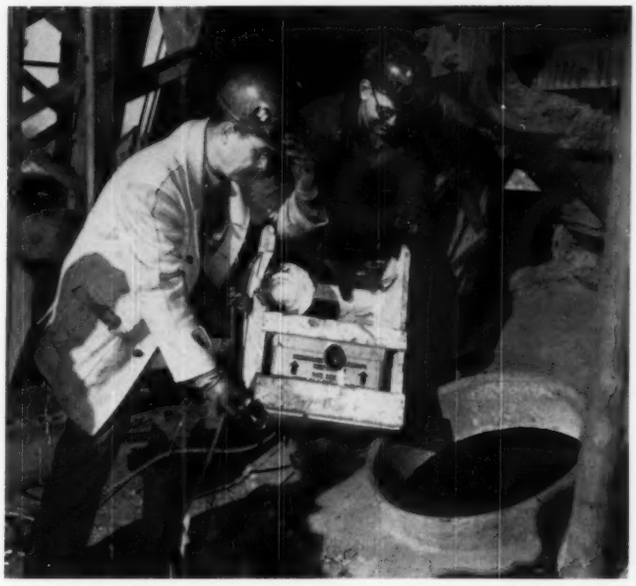


Figure 4 — Men get ready to lower equipment down big bell of furnace.

had stopped, and each time the camera had been brought out it had to be taken out of the wooden box, then out of the cardboard box to reload it and reset the shutter.

Since John Monson was anxious to see the pictures as soon as possible, the film was rushed to the darkroom and processed for 5 min in DK 50 developer. That's when it was found that eight blanks had been shot. A voltage drop along the 40-ft extension cord had caused a delay in the synchronization system. By the time the bulb had gone off, the shutter had already clicked and was shut tight. The negatives were positively negative.

Obviously a faster and better lens, plus perfect synchronization was needed. A power booster might help, too.

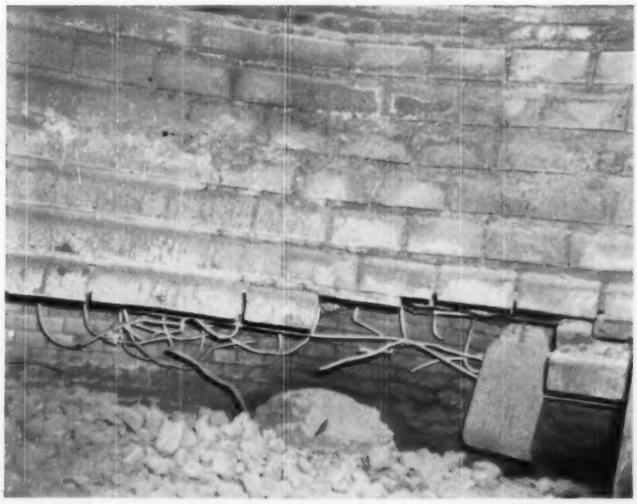
Removing the lens, the photographer drilled holes in the front plate of the camera and bolted on a lens board on which he fitted a 4.7 speed Graphic lens with built-in synchronization, a mechanism designed to trigger the shutter and fire off the bulb simultaneously when an electrical impulse is sent through it. The lens was connected by a short cord to the three-battery flash gun carrying the bulb and held onto the camera by a bracket. Then one end of the 40-ft cord was plugged into the solenoid and the other end into a five-battery flash gun without a bulb. In effect, this gave eight batteries, instead of three, and two separate mechanisms to insure against a second failure.

Shortly thereafter another try was made at photographing the insides of "A" furnace, using the same focus, lens and shutter settings as before. This time John Monson got clear and sharp prints. The stock armor line section inside "E" furnace was photographed next successfully.

The success of what started out as an experiment will have an important bearing on future jobs of similar nature. For one thing, it has proved that the versatile camera can penetrate areas barred by safety sense to human beings, a feature that gives new scope to the range of its usefulness as a working tool. ▲

Figure 5 — Clear and sharp pictures show damaged stock line armor below big bell of furnace. Worn-out lining makes repair job a must.

Figure 6 — View shows condition of interior of "E" furnace.



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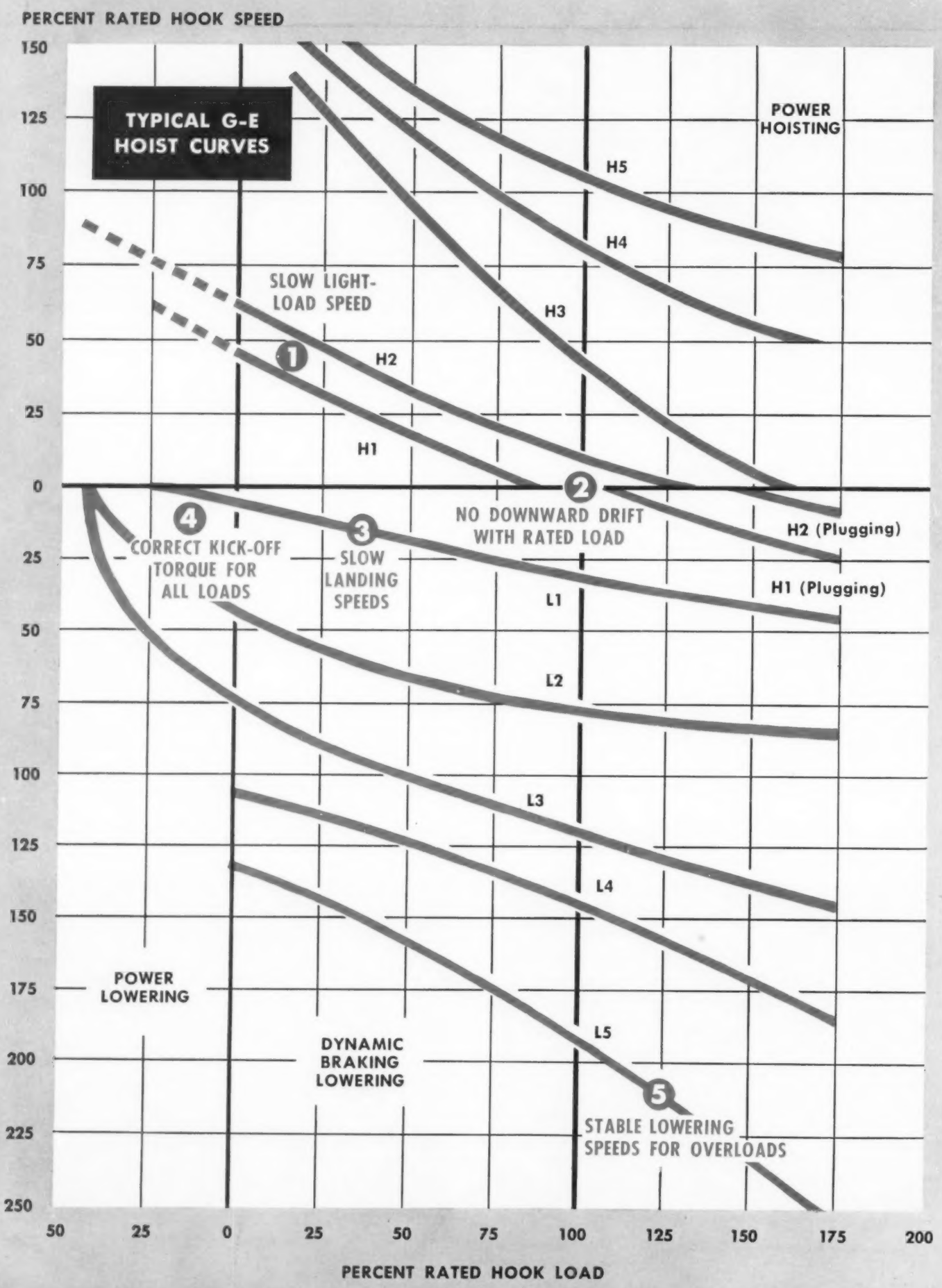

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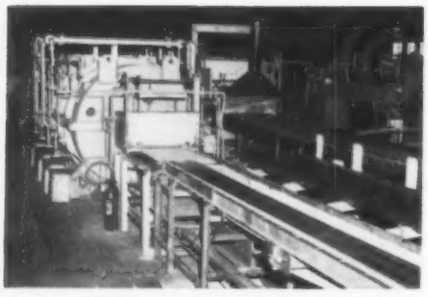

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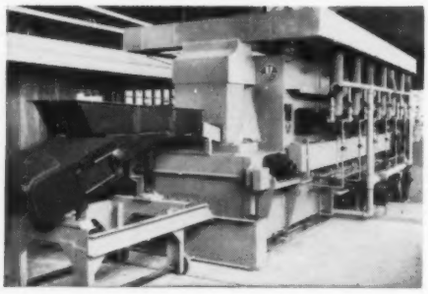
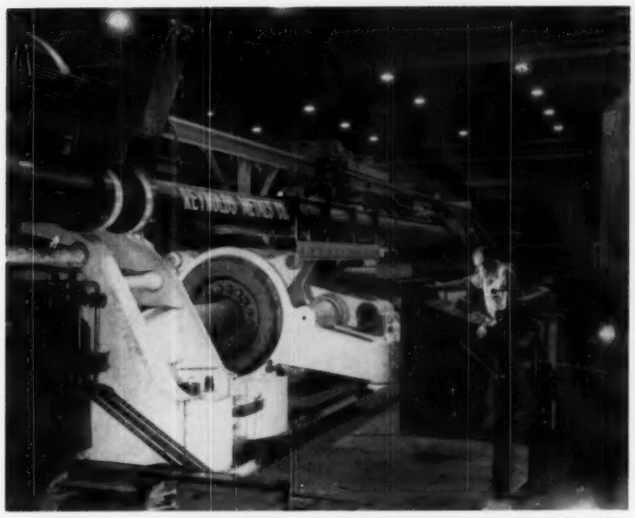


EF gas fired radiant tube combination hardening and dry cyaniding unit fitted with an automatic feeder that distributes the parts evenly on the chain belt conveyor.

Figure 1 (left) — This huge extrusion press weighs 2,000,000 lb and is 90 ft long. Figure 2 (right) — Although this extrusion press is one of the largest of its kind in operation, it requires but two men to operate it. The major portion of the operation is handled from the control board pictured while another man sits at a smaller control board on the other side of the press.



Reynolds Metals Co. Operates New Navy Extrusion Press

A NEW $2,500,000, 6000-ton extrusion press at the Reynolds Metals Co. plant recently went into operation for the U. S. Navy.

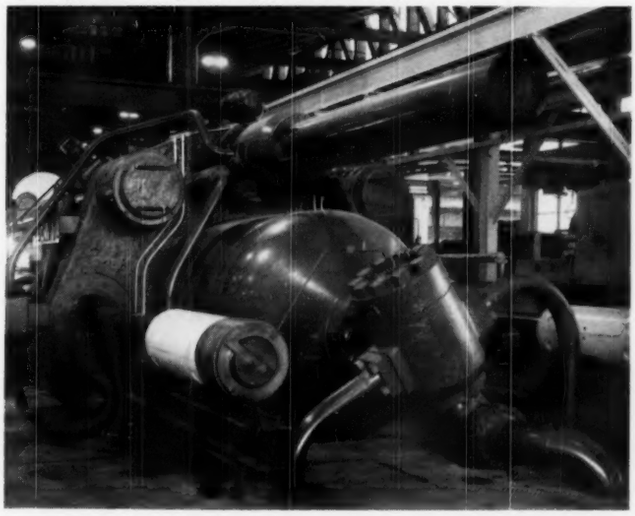
The new extrusion press, probably the largest of its kind in Arizona, is one of the largest extrusion presses owned by the U. S. Navy. It will be operated by Reynolds to extrude aircraft shapes and other defense materials for the Navy.

Designed and built by Loewy-Hydropress, Division of Baldwin-Lima-Hamilton Corp., New York, the press has a capacity of 6000 tons and is designed for closest concentricity and for easy change from low speed to high speed without changing of valves. The operator can, therefore, switch by pushbutton

(*Please turn to page 143*)

Figure 3 — The billet is inserted here in this 6000-ton extrusion press.

Figure 4 — The press, owned by the Navy, will be operated by Reynolds to produce aircraft shapes.



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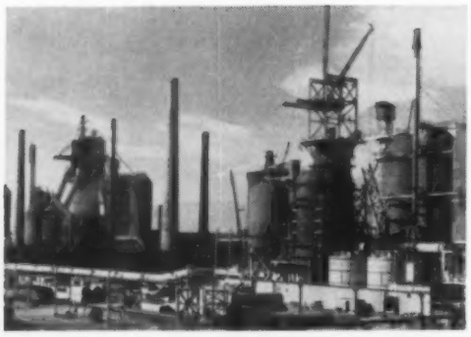

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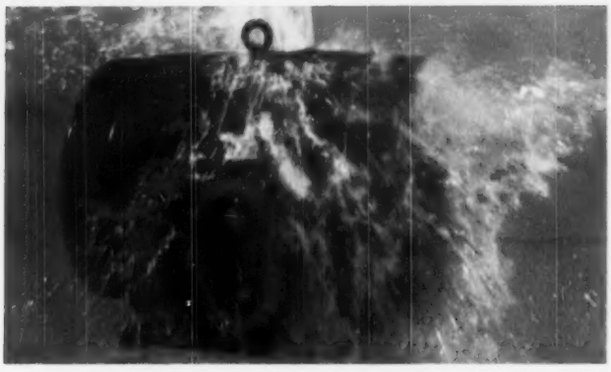

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SLEEVE BEARING MODELS AVAILABLE

The entire line of ratings through 125 hp is available with ball bearing construction as illustrated, or with steel-backed, babbitt lined sleeve bearings that have high load carrying capacity and provide quieter operation.

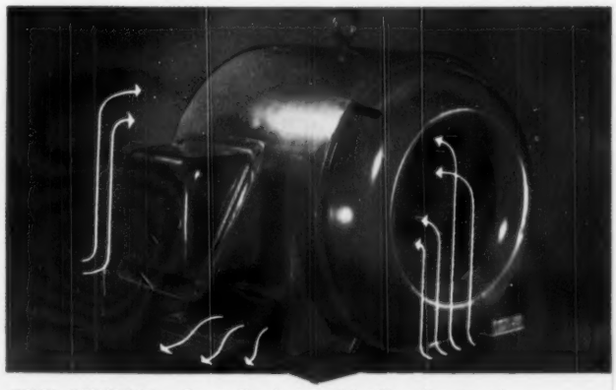
Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

1 to 125 HP—1750 RPM—40°C
NEMA FRAMES 182 through 445U

Wagner Electric Corporation
6400 Plymouth Ave., St. Louis 14, Missouri.

WM58-9

CAN BE RELUBRICATED—Factory lubrication will last for many years in normal service—but openings are provided to permit the relubrication that adds years to motor life under severe conditions.



COOL RUNNING—Specially designed baffles direct cooling air through the motor to reduce stator temperature—thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

YOU GET
EXTRA PROTECTION
against corrosive... abrasive or explosive elements

with Wagner totally enclosed motors... protected for longer motor life

If you need motors that will keep production rates up... that will give the continuity of service that is so important to automation... that will operate with complete dependability under the most severe conditions —Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well — designed and approved for use in explosive atmospheres.

NEW NEMA FRAMES—These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life.

Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 [illegible] 100 HORSEPOWER—4 POLE, 60 CYCLE—NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation

6400 Plymouth Ave., St. Louis 14, Missouri. Branches and Distributors in All Principal Cities

HEAVY DUTY BALL BEARINGS

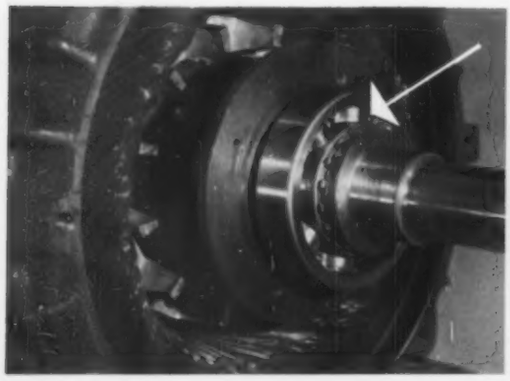
The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

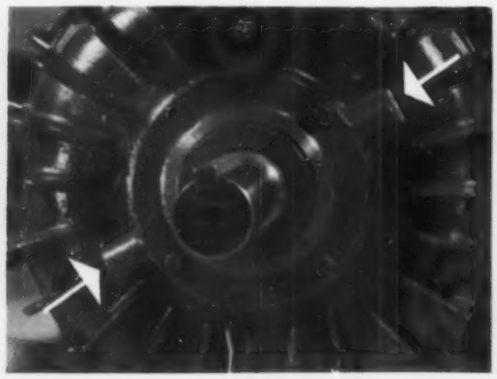
BEARINGS CAN BE RELUBRICATED

Factory lubrication will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN

Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.





(*Continued from page 139*)

from the working of nonferrous metals to the extrusion of steel and titanium.

Change of containers, which in conventional extrusion presses, requires many hours, can be performed in 20 to 30 min on this press. Another interesting innovation is an independent mandrel mover. The mandrel can be stopped independently from the press movement, which makes it possible to extrude shapes of unusual design such as small, hollow configurations.

The press is equipped with an automatic constant-speed control, an automatic billet loading system and a semi-automatic butt and dummy block handling device. The press is also designed for the application of rectangular containers for extremely wide and thin extrusions. A special device in the machine provides for the handling of split-dies for step extrusion. The height of the runout table—as a whole unit—can be adjusted to the different die configurations. Details are given in Tables I and II. ▲

TABLE I
6000-Ton Extrusion Press Specifications

Press capacity, tons	6300
Press stroke, in.	122
Main ram diameter, in.	59½
Mandrel capacity, tons	1000
Mandrel stroke, in.	66
Piercer ram diameter, in.	23¾
Maximum length of billet, in.	48
Maximum diameter of billet, in.	20
Maximum billet for rectangular container, in.	30 x 4
Maximum round extrusion, minimum diam, in.	18
Maximum width of flat extrusion, in.	28
Maximum mandrel diameter, in.	14
Container length, in.	54
Container stroke, in.	40
Container shifting capacity, tons	320
Container (die) sealing capacity, tons	300
Main ram pull-back capacity, tons	700
Mandrel ram pull-back capacity, tons	400
Butt shear capacity, tons	200
Butt separator capacity, tons	160
Die slide shifting capacity, tons	19
Butt saw capacity, tons	9
Butt saw cutting speed, fpm	6500
Butt saw blade diameter, in.	55
Die shifting capacity—open, tons	44
Die shifting capacity—closed, tons	17
Extrusion stripper capacity, tons	25
Maximum working pressure, psi	4500
Maximum prefill pressure, psi	300
Main ram fast advance speed, in. per min	720
Main ram return speed, in. per min	720
Main ram extrusion speed for Al (max), in. per min	60
Main ram extrusion speed for Fe (max), in. per min	800
Mandrel forward speed (max), in. per min	360
Mandrel return speed (max), in. per min	720
Method of container heating	Electric resistance type
Maximum container temperature, F	1000
Maximum temperature variation, F	100
Main cylinder fabrication (welded)	
Laminated welded steel shell with cast steel ends, tons	66
Main cylinder crosshead casting tons	57½
Moving crosshead casting, tons	63
Platen casting, tons	54
Tie rods—length 62 ft-11¼ in., tons	24½
Over-all length of press (approx.), ft-in.	90-0
Width of press, ft-in.	11-0
Billet weight (18-in. diam x 48 in.), lb	1245
Weight of press proper (approx), lb	2,000,000
Length of runout table, ft-in.	100-0

TABLE II
6000-Ton Extrusion Press Auxiliary Equipment

Magnethermic induction billet heater
- Heating rate 5000 lb per hr to 800 F per heater
- Maximum temperature—1050 F
- Power supply—4160 volts, 3-phase, 60-cycle
- Power factor—0.85 lagging
- Power rating—500 kw per heater
- Coils water cooled—inlet water temperature 90 F maximum at 50 to 100-psi treated water
- Heater supplied with coils for 11-in. diam, 14-in. diam, 16-in. diam, and 18-in. diam x 48-in. long billets
- Recirculated treated water for controlling heater temperature is cooled by evaporative condenser rated to cool 650 gpm from 101 to 90 F with entering air at a wet bulb temperature of 78 F
- Heat rejection rate 3,575,000 Btu per hr

High pressure hydraulic system, 4500 psi
- Six Worthington triplex single acting hydraulic pumps. Each pump has three plungers with 3⅜-in. bore x 16-in. stroke, delivering 100 gpm per unit at 600 rpm. Electric drive motors are 300 hp
- Five Accumulator bottles, consisting of three air bottles and two air and treated water bottles. Each bottle stands 15 ft-0 in. high x 30 in. inside diameter with minimum wall 4.85 in., of laminated steel welded construction

Scrap Processing Plant Makes Use of New Technological Improvements

CONSTRUCTION of a new and modern scrap processing plant has just been completed at Davenport, Iowa. The combined facilities of Alter Co. and Alloy Metal Products, Inc., cover 42 acres of plant site and contain the most modern and efficient scrap processing machinery available. Every facet of the plant's design and construction has been keyed to high production and maximum efficiency.

Alter Co.'s iron and steel scrap processing plant covering over 20 acres of production area, has nearly five miles of railroad track within the plant serving all scrap preparation facilities. The outstanding feature of the plant is a model 3000 Harris scrap baling press, the largest machine of its type ever devised. This hydraulic monster is capable of reducing three complete automobiles to a bundle of steel measuring 60 x 60 x 24 in. in a matter of 90 sec.

Most steel mills are unable to use a steel scrap bundle of this size due to limitations of charging doors, therefore the normal bundle contains one scrap automobile. This machine in a normal 8-hr shift will hydraulically compress over 350 tons of scrap, ready to be charged into an open hearth furnace.

Scrap material is fed into the Harris press by a specially designed mill type Shaw Box overhead crane which is equipped with a 65 in. eight coil Ohio electromagnet plus a large orange peel for handling excessively bulky material. This overhead crane was specially engineered to match the operating cycle of the baling press. It handles the complete task of unloading carloads of scrap, feeding the press and reloading the finished bundles into railroad cars with complete ease.

The operator of the press is stationed in a completely air conditioned control center atop the press building from which vantage point he can view all operations of the baling plant.

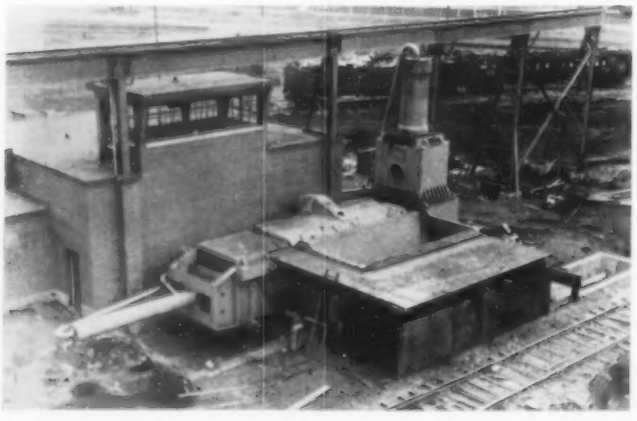
The entire plant is co-ordinated by Motorola frequency modulation (FM) radio, and each crane, switch engine, manufacturing facility and railroad and truck scales, are a part of the intra-plant radio network. The plant superintendent carries a portable radio with him at all times so that he may be in constant communication with all plant operations.

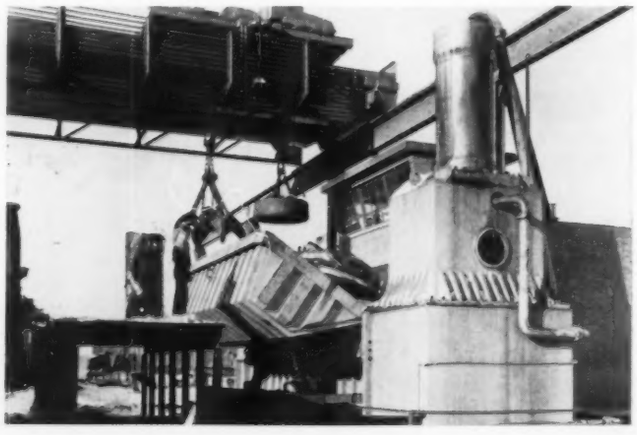
Scrap received by truck is weighed over a specially designed 60-ft Fairbanks-Morse scale which not only weighs the material, but marks its particular grade, price and total value on the face of the check, as well as on multiple copies of scale tickets. As each load is received at the truck entrance, the weighmaster radios a description of the type of scrap each load contains to the particular manufacturing facility to which it is consigned. Should there be any discrepancy in the load, the weighmaster is immediately notified by the radio of such difference so that adjustments may be made immediately with regard to the particular grade of scrap.

All carloads of scrap entering the plant are weighed on a 150-ton Fairbanks-Morse track scale which is also linked into the radio network.

The scrap preparation plant has been laid out in such a manner as to

Figure 1 (left) — The baling press has its operator's console atop the service building. Bundles are ejected beyond the hopper to the right. They are pushed under the hopper platform by the ram visible at far right into a position where they may be loaded into cars by the overhead crane with a minimum of crane bridge travel. Figure 2 (right) — The hopper of the baling press dumps an automobile body into the accumulator ram charger. Material is fed to this press by a special design 15-ton overhead crane which must keep abreast of the 90-sec press operating cycle. A typical bundle from this press is shown on the hopper platform weighing 2400 lb, measuring 20 x 24 x 60 in.





CUTLER-HAMMER'S 4105 TYPE A SAFETY SWITCH WITH DUO-STRENGTH OPERATING HOOKS ADDS NEW SAFETY TO SAFETY SWITCH PERFORMANCE

This is the finest, most modern safety switch . . . the new Cutler-Hammer 4105 Heavy Duty Type A Safety Switch. Tested and proven superior, the new C-H 4105 combines the famous C-H "heat proof dependability" with a new high-strength construction for safer, positive switch performance. Plant electricians, engineers and contractors solidly recommend and install Cutler-Hammer 4105 safety switches for every heavy duty application, and here's why.

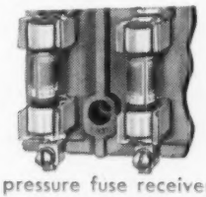
The new duo-strength operating hook and hook insulator insure the dependable performance so vital to reliable safety switch operation. The hook is made of high-strength steel and the insulator of glass fibre Alkide, known for its exceptional dielectric strength. The all-steel linkage between the contact blades and operating handle will faithfully open and close the switch blades even after years of continuous service. The Alkide hook insulator and operating rod insulating sleeve provide double insulation for double-sure safety.

Other important features of design include new automatic pressure fuse receivers; no screws to tighten . . . fuse can't work loose or be left loose while in service. Visible contact blades for quick, sure inspection at all times. Panel mounted mechanism of this new 4105 safety switch is readily interchangeable with that of the previous 4101 design for rapid replacement without case-and-conduit work.

Your nearby Cutler-Hammer Distributor is stocked and ready to serve you. Pick up your C-H 4105 safety switch today and see his complete line of electrical controls by Cutler-Hammer—leading manufacturer of *Automation Control*. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
SAFETY SWITCHES
C-H

High strength glass fibre Alkide hook insulator and sleeve type operating rod insulator form the finest electrical safety. Hook is of high-strength steel for long-lasting switch performance.



Automatic pressure fuse receivers maintain uniform clip-to-fuse contact. Fuses won't work loose . . . no tools required to install fuses.

Sub-base panel mounting simplifies maintenance . . . quick, sure, economical. New 4105 mechanism will fit 4101 style case; no new case or conduit work.

Available in sizes from 30 amperes to 1200 amperes; 2, 3, and 4 poles; fusible and non-fusible.

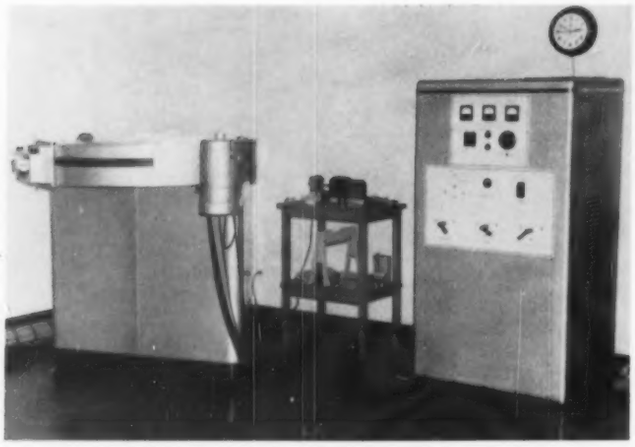


Figure 3 — The 1.5-meter spectrograph gives a picture of the spark spectrum from any metal sample. It is particularly useful in determinations of trace elements to thousandths of a per cent. This unit serves both the sorting department as well as product quality control.

Figure 4 — The sorting department sees all inbound alloy shipments. Here, an experienced crew employs spark wheel and reagent tests in comparison with known samples for quality inspection and segregation of mixed alloys. Unusual and off standard alloys are verified with the laboratory.

utilize the most modern production techniques and the flow of materials follows the familiar assembly line techniques of many other types of manufacturing plants.

In addition to the highly mechanized scrap baling operation, the plant utilizes many shears and flame cutters for preparation of other types of iron and steel scrap for foundry and steel mill use.

An effort has been made to mechanize each scrap preparation facility to the maximum possible extent. By doing this, the company has reduced operating cost to a minimum and can thus better serve its hundreds of customers more efficiently and effectively.

The secondary nickel plant of Alloy Metal Products, Inc., occupies production facilities encompassing over 200,000 sq ft of building space and 22 acres of land. Alloy Metal Products, Inc., a manufacturer of secondary nickel alloys, supplies alloys for steel mills, foundries, investment casting plants and many other specialized users of nickel and its alloys throughout the United States and the free world.

The nickel scrap receiving, segregation, and preparation plant occupies over 100,000 sq ft of building space devoted almost entirely to the preparation of raw material for the company's melting facilities.

Scrap received by rail or truck is immediately given a lot number which it carries as an identification mark through its entire circuit of the scrap segregation and preparation plant. The material after being weighed and tagged is moved to the sorting area where each piece of nickel alloy scrap is sorted manually to determine its proper value. Sorting is done laboriously and with great care, utilizing qualitative chemical tests, spark identification and other highly specialized means of segregation. Any scrap not conforming to a specific grade is sent to the laboratory for complete chemical analysis.

After the scrap nickel alloys are sorted, they are sent to the preparation area where they may be hydraulically compressed, sheared or cut with ferro-jet lances so as to make them suitable for charging into electric furnaces. Turnings are sent to the crushing and separating area where the material is crushed, then passed through Sterns differential magnetic separators which remove all foreign elements.

From the various preparation facilities, the material is moved to stock storage to await its use by the melting department.

Upon requisition by the melting department, the material is moved to the heat making department, where various and sundry nickel alloys are blended together into heats of 1200 to 6000 lb to be melted into the variety of alloys which the company manufactures. Frequently, as many as 15 different alloys of nickel are blended together to manufacture a single standard master alloy or special alloy.

The material is next moved from the heat making department to the 40,000-sq ft melt shop where it may be melted in a top-charge Swindell-Dressler electric arc furnace or in Ajax high frequency electric induction furnaces, or gas fired Crucible furnaces, or blast furnaces, depending on the character of the metal and customer requirements. After melting, the material is cast into pig, shot or special shapes, depending upon end use. It is then packaged in shipping containers and returned to the shipping department.

Alloy Metal Products, Inc., maintains one of the most complete metallurgical laboratories in the country. In addition to a complete wet laboratory, the company uses an Applied Research x-ray industrial quantometer and an Applied Research spectrograph.

The quantometer is a highly specialized unit which utilizes alpha, beta and gamma radiation for the determination of analyses. Within one minute from the time a sample is introduced into the quantometer, a complete chemical analysis of its major elements is recorded in graphic form.

Residual elements are determined on the Applied Research spectrograph which will deliver a finished film ready for densitometer determination within 15 min.

Since nickel and its alloys are used in the most critical of metal applications, quality and accuracy must be the watchword in every phase of the plant operation.

Certain elements must be controlled to an accuracy of one-thousandth of a per cent, and in some cases a ten-thousandth of a per cent.

Alloy Metal Products, Inc., and the Alloy Metal Div. of Alter Co.

It's PECOR at this new steel mill

. . . as in most key steel plants

This new PECor teeming ladle is one of several now serving the new electric furnace installations at this large Southern Steel Plant.

PECor ladles offer highest efficiency from the standpoint of capacity vs. hook loadings . . . ease of handling, relining, etc.

For better engineered, high-duty ladles and other steel plant equipment—look to the leader for the past 75 years—PECor.

Write...

- **For facts about the new PECor lightweight ladle!**
- **For facts about rebuilding ladles to larger capacities at half the cost!**

PENNSYLVANIA ENGINEERING CORPORATION

NEW CASTLE, PENNA.

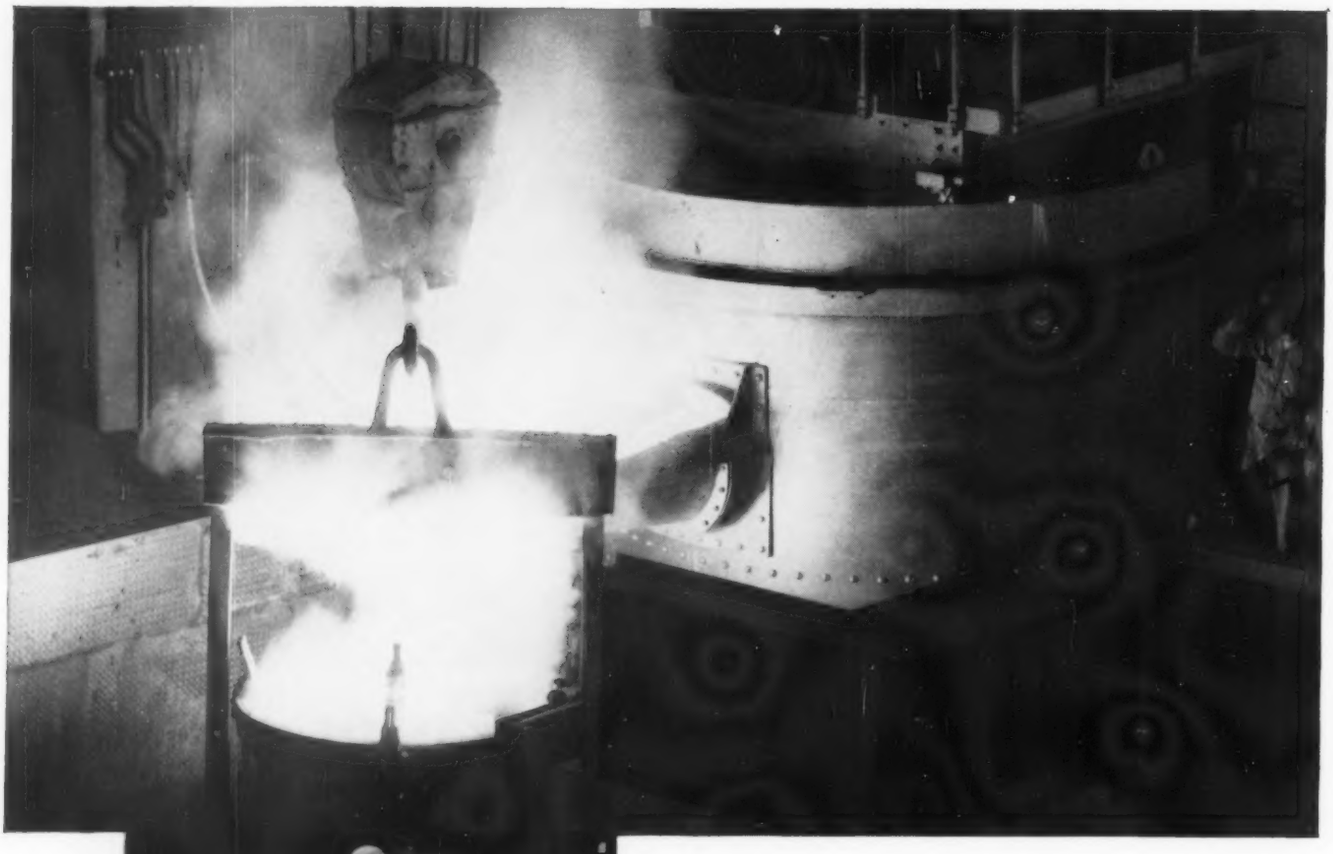
OTHER STEEL PLANT EQUIPMENT WE BUILD

Blast Furnaces • Scrap Cars • Slag Cars • Oxygen Converters • Bessemer Converters • Hot Metal Mixers • Ore Transfer Cars • Ladles • Jack Cars • Ladle Transfer Cars • Ingot Cars • Mixer Cars • Thermo Metal (Bottle) Cars • Scale Cars

ENGINEERS • FABRICATORS

PROGRESS IN ROLL MAKING

electric melting for large steel rolls



Preparing mold for grooved steel roll.

NEW—

THE ELECTRIC FURNACE you see has recently been installed in our new steel foundry building for the production of *large* steel rolls.

To meet customers' specific requirements for every roll use, National now has a wide range of sizes of electric furnaces permitting controlled metallurgical composition regardless of roll size.

The new electric furnace is typical of big things that are happening at National—new facilities, new equipment, new processes to give you better, longer lasting rolls. Specify National rolls.

GENERAL STEEL CASTINGS CORPORATION

National Roll & Foundry Division

Avonmore (Westmoreland County) Pennsylvania

General Steel Castings Corporation: General Offices, Granite City, Ill.

Plants: Granite City, Ill. — Eddystone, Pa. — Avonmore, Pa.

serves the unique and unusual function of taking a wide variety of nickel alloys, some of which would be highly undesirable in their original form, and converting them into technically perfect, highly desirable alloying agents for many segments of the metal working industry of the world. Many years of research and planning have gone into all of the company's products and facilities so that it is now considered to be the major world factor in secondary nickel alloy production.

The plant maintenance department occupies a 10,000 sq ft building equipped with the very latest power tools and repair equipment for proper servicing and maintenance of all production machinery and material handling equipment.

The maintenance department is linked to the FM radio network so that service crews can be sent to any required part of the plant for instant repair service.

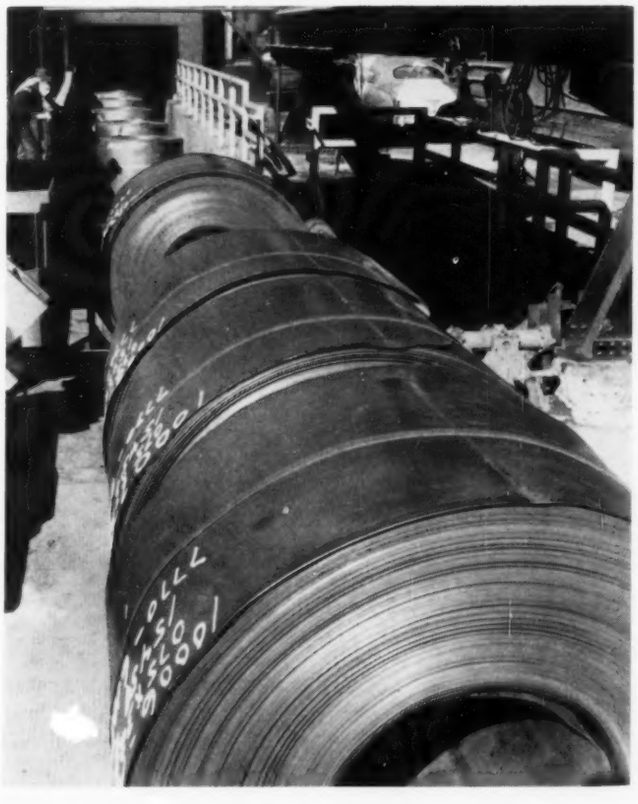
The Alter Waterway Terminal Corp. operates a large barge terminal for the shipment of all grades of scrap on the Mississippi River. The waterway terminal is geared to handle 1000 gross tons per day from railroad cars and trucks into barges which carry scrap to various parts of the country on the Mississippi and Ohio Rivers and their tributaries. The waterway terminal is also linked in the radio network for instant communications with the main plant.

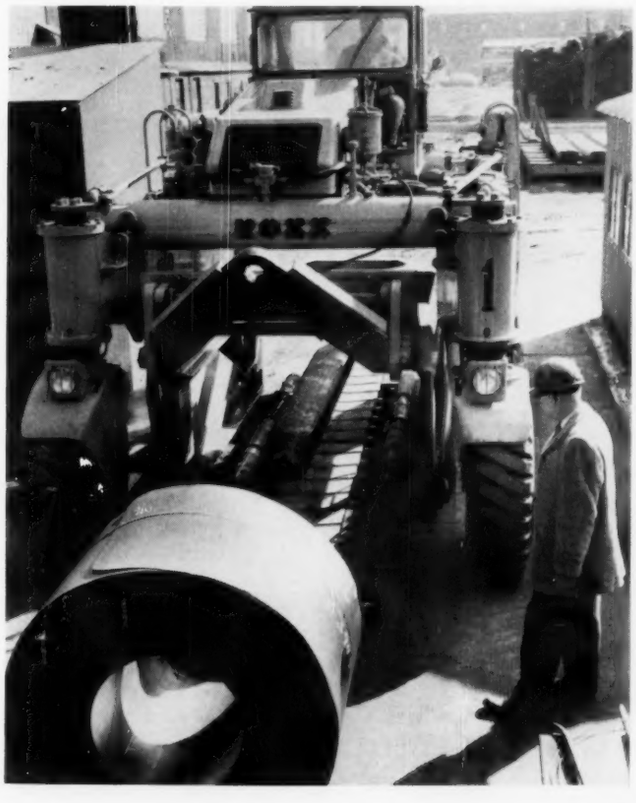
Future plans also call for the installation of a closed circuit television system covering all operations within the plant. This will enable executives to view many operations within the plant without leaving their desks. This is but one of the many time-saving devices which marks this plant as being the most unique scrap processing operation in the entire nation. ▲

Carrier Units Speed Coil Delivery

A NEW materials handling system, designed for transportation of the product of a new 44-in. hot strip rolling mill has been placed in operation at the Aliquippa, Pa., plant of the Jones & Laughlin Steel Corp. J & L recently installed the 44-in. hot strip mill to roll coiled skelp and coiled strip steel for use in the tin plate department and in the new electricweld and continuous weld pipe mills at the Aliquippa Works. Previously, the coiled skelp and strip for these finishing mills had been produced on the hot strip mills at J & L's Pittsburgh and Cleveland Works and transported via rail to the Aliquippa plant.

Figure 1 (left)—Coils of strip steel from the hot strip mill can be delivered to the finishing mills within minutes, thanks to a new material handling system. Coils are emerging from the strip mill on a specially designed outlet conveyor. Figure 2 (right)—Carrier prepares to pick up a coil of strip steel. Carriers carry up to 5000 lb of coils suspended on the mandrel bar under the carrier framework.





Under the new material handling and transporting system, coiled skelp and strip steel can be transported to the respective finishing mills within minutes after rolling on the strip mill.

Developed by J & L, the new system involves a specially designed outlet conveyor at the strip mill, use of Clark-Ross "over-the-load" carriers for pickup, transport and laydown of coils, coil storage areas or depots adjacent to the finishing mills and a simplified system of accounting which permits ready identification of coils for scheduling and inventory purposes. In addition, a new plant roadway was built from the strip mill to the South mills area where the finishing mills are located. This new roadway crosses Logstown Run, a small creek which bisects the plant, and thus establishes an almost straight line carry from the strip mill to the electricweld and continuous weld pipe mills.

As skelp or strip in individual coils weighing on an average about 7½ tons are deposited on the special conveyor at ground level, they are assembled in groups of three or more to a maximum weight of about 25 tons, picked up by the Ross carriers and transported to a predesignated coil storage area or directly into the finishing mills in the case of immediate use. Neither overhead crane service nor rail service is required.

The round trip per carrier from the strip mill conveyor pickup point, and with a relatively constant load of about 20 or 25 net tons, requires 20 min or less. The longest haul in the operation involves a distance of about 1¾ miles equivalent to about 3½ miles round trip.

Four carriers will be in service at one time to service the strip mill and the finishing mills. However, to provide for breakdowns, five Ross carriers, each with a load capacity of 25 tons, have been leased from Material Handling, Inc., of Pittsburgh, Pa. They are manufactured by the Ross Carrier Div. of the Clark Equipment Co.

Each of the Ross carriers has been equipped with a specially designed 12-ft ram about 1 ft in diameter mounted in a steel framework and attached to the regular "shoes" of the carrier hoisting mechanism. The entire device is suspended under the carrier framework between the wheels.

This suspended ram device also has a front end swinging gate which, when lowered, acts to interlock with the front end of the ram permitting the entire load to be raised from the ground with the ram. Then the load of coils is suspended under the carrier with uniform distribution of the total load to the four wheels.

This is unique in that it permits the carrying of considerably more weight on the ram than does the typical ram tractor and yet eliminates the necessity for hauling the load (coils) on pallets. Use of pallets is inherent in the normal design and functioning of the Ross carriers and is the regular practice with "over-the-load" carriers of this type.

Although designed and installed to provide for handling and transporting the product of the new strip mill with a minimum capital investment, as compared to other known methods of handling and transporting, Jones & Laughlin foresees improved order service to tin plate, electricweld pipe and continuous weld pipe customers through better internal scheduling and improved producing flexibilities in these lines. ▲

SUPERIOR
CARBON
BRICK
FOR

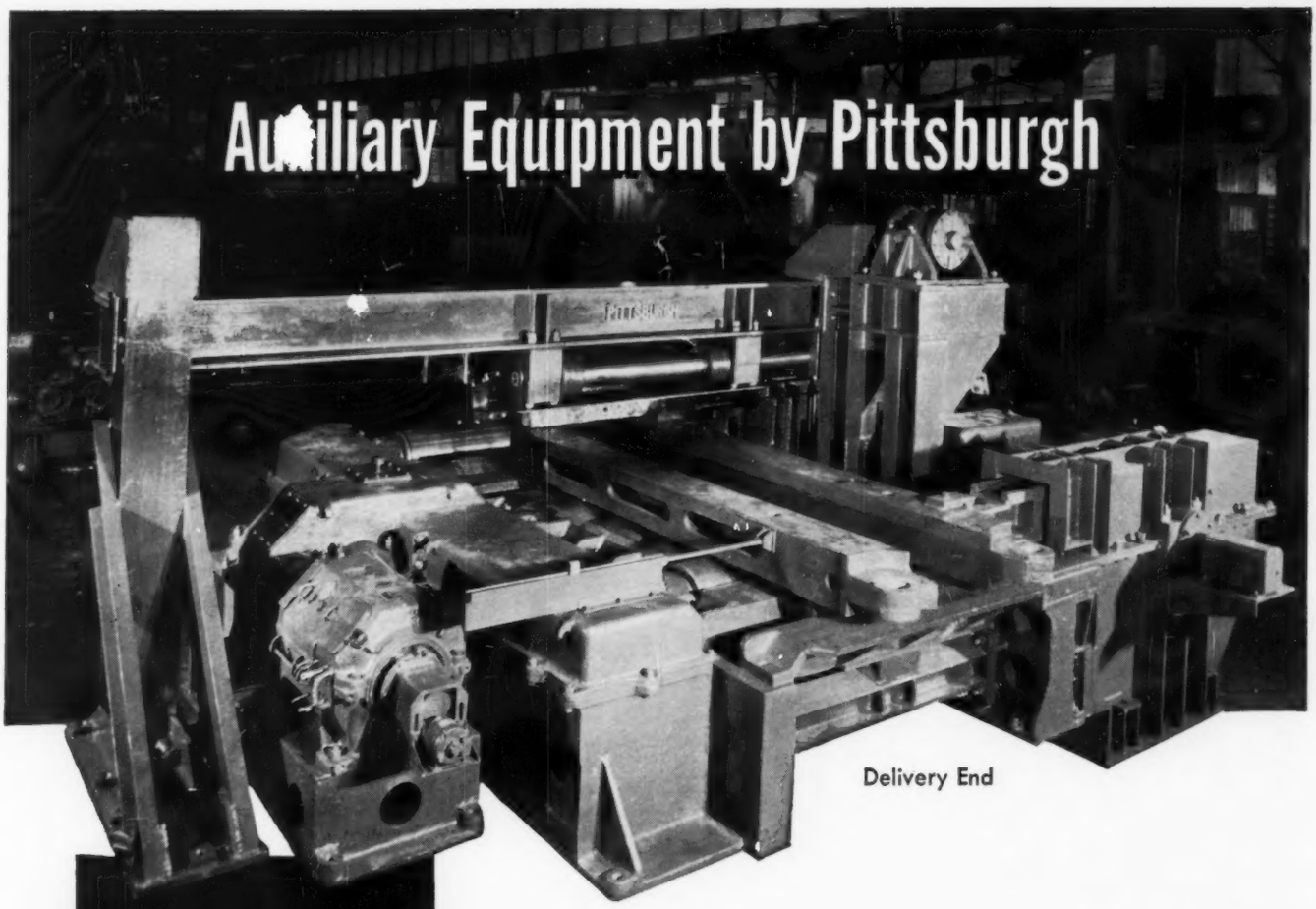
◀ Blast furnace linings
◀ Blast furnace run-out troughs
◀ Cupola linings
◀ Steel pickling tanks

Standard sizes and shapes • Tested performances
Competent technical service • Superior chemical and metallurgical characteristics • Graphite brick also available.

May we give you a quotation?

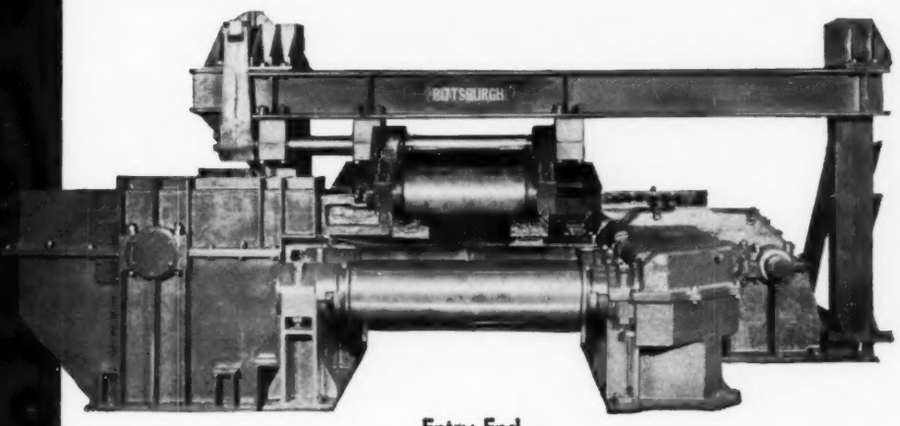
ELECTRODE GLC® DIVISION
GREAT LAKES CARBON CORPORATION
18 EAST 48TH STREET, NEW YORK 17, N.Y. • OFFICES IN PRINCIPAL CITIES

Auxiliary Equipment by Pittsburgh



Delivery End

slab scarfer table with holddown roller and adjustable guides



Entry End

This Slab Scarfer Table is a typical example of the wide variety of auxiliary mill equipment designed and built by Pittsburgh Engineering and Machine.

Slabs from the blooming mill are scarfed on all four sides in an adjacent unit thus eliminating 1/64-1/32" of scale and other surface irregularities.

We can help you with your requirements for primary and auxiliary mill equipment.

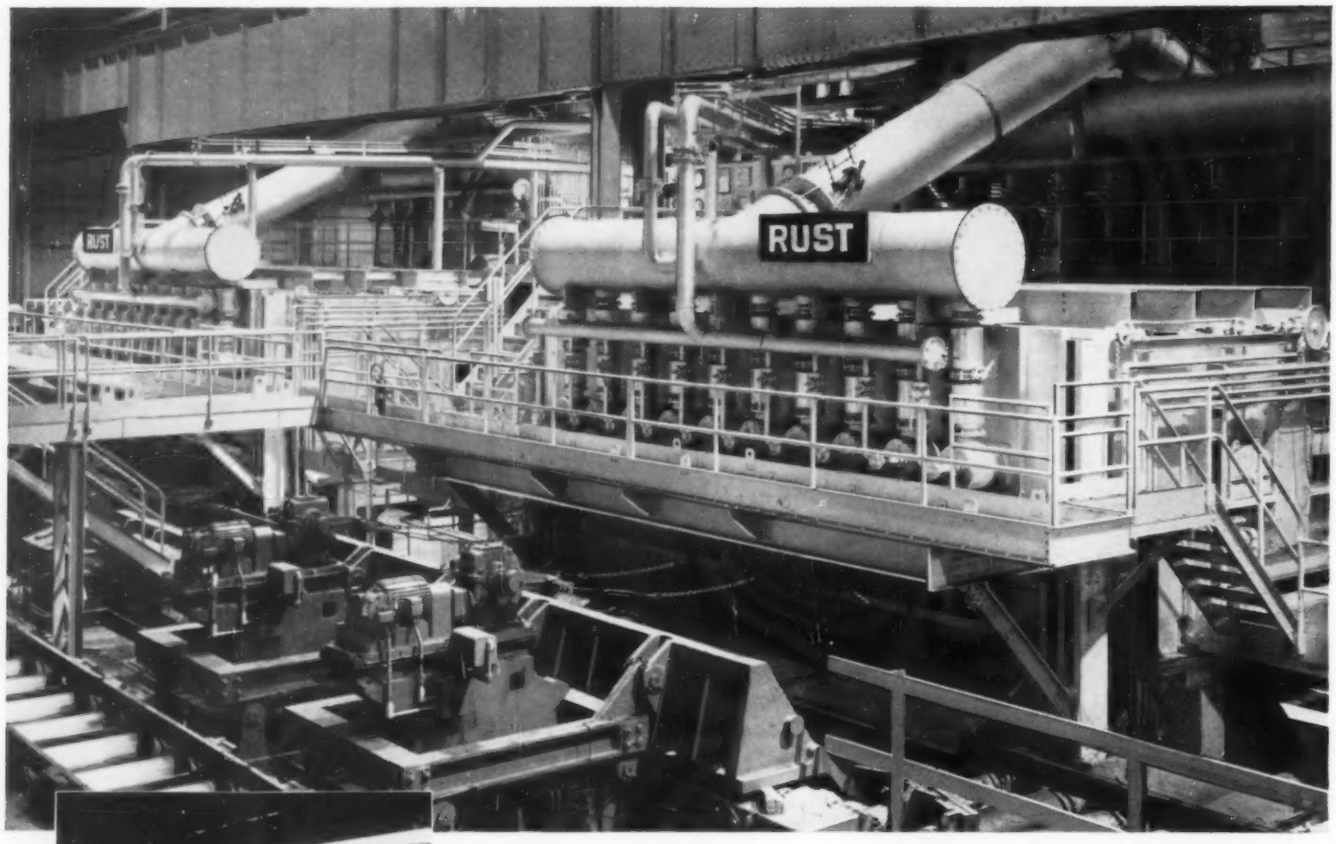
"Electric and open hearth steel castings from 1 lb. to 100 tons"

Pittsburgh
ENGINEERING & MACHINE

Division of Pittsburgh Steel Foundry Corporation
P. O. BOX 986, PITTSBURGH 30, PENNSYLVANIA
PLANT AT GLASSPORT, PENNSYLVANIA

For the industry's first fully-automatic reversing rougher mill...

ASKANIA FURNACE CONTROLS



Furnace control center is at the two Askania control panels, where a complete picture of furnace operation is at the operators' fingertips. A notable feature of the control arrangement is the ease of changing over from gas to oil firing in any of the three independently-controlled zones.

Supplying the hot slabs for the steel industry's first fully-automatic, punch-card-operated reversing rougher unit—in the new hot strip mill of the Aliquippa Works of Jones & Laughlin Steel Corporation—is the job of these two new slab heating furnaces designed and constructed by the Rust Furnace Company.

And keeping the furnaces operating efficiently is the job of Askania Combustion Controls. Furnace pressure, fuel-air ratio, and fuel gas pressure are all Askania-controlled from two central panels like the one pictured here.

Here, again, is an example of Askania straight-line control engineering at work—simple, straightforward equipment and systems, *controls for steel,* designed by *men who know steel!*

Specify Askania controls for every furnace, coke oven, gas mixing, blower control, and strip guiding application. Call your local Askania office, or write direct to Chicago for your copy of the complete, informative Askania catalog.

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Date-line Diary...

March 1

△ F. W. Dodge Corp. reports that January, 1958, construction contracts totaled $2,066,059,000, ten per cent below January, 1957.

March 3

△ The AISI reports that the operating rate of the steel industry for the week of March 3 is scheduled at 1,419,000 tons. This compares with 1,475,000 tons one week ago (54.6 per cent capacity) and 2,411,000 tons one year ago. Index of production for the week is 88.3.

△ Allis-Chalmers Mfg. Co. reported 1957 sales totaling $534,146,214, net profit $17,353,653, or $2.11 per share. For 1956 sales amounted to $547,439,265, net profit was $19,719,188 or $2.42 per share.

△ Industrial Heating Equipment Assn. reports that new orders for industrial furnaces in January, 1958, were $3,045,000, compared with $7,380,000 in January, 1957; orders for induction and dielectric heating equipment in January, 1958, were $630,000 compared with $744,000 in January, 1957.

March 4

△ The Aluminum Assn. reported that shipments of aluminum sheet and plate in January, 1958, totaled 88,251,000 lb, compared with 75,962,000 lb in December, 1957; shipments of aluminum foil in January, 1958, amounted to 17,253,736 lb, compared with 15,438,262 lb in December, 1957.

March 5

△ The Federal Reserve Board reported that consumers reduced the installment debt $368,000,000 in January, 1958, compared with $259,000,000 in January, 1957. Total installment credit outstanding amounted to $33,700,000,000, still $2,200,000,000 over January 31, 1957.

△ Henry J. Kaiser informed shareholders of the Kaiser Steel Corp. that the corporation expects to spend a total of $214,247,000 for its expansion program started in early 1956, $20,000,000 more than originally anticipated. Expenditures had reached $137,875,000 at December 31, 1957, and most of the balance of the program will be completed this year.

March 6

△ The AISI reports estimated payroll for the iron and steel industry for January, 1958, amounted to $297,365,000, compared with $299,560,000 in December, 1957, and $360,620,000 in January, 1957. Estimated total employment was 575,300 compared with 606,200 in December and 677,600 in January, 1957. Average hourly payroll cost per wage earner was $3.040 plus 30¢ fringe, compared with December cost of $3.006. Average hours worked a week was 35.2 compared with 32.9 in December.

March 7

△ The Commerce Dept. reported that manufacturers' inventories at the end of January were valued at $52,900,000,000, down $600,000,000 from December on a seasonally adjusted basis, and compared with $400,000,000 decline November to December.

△ Government figures showed that construction expenditures in February, 1958, amounted to $3,100,000,000.

△ The Bureau of Mines reported that production of Pennsylvania anthracite for February, 1958, equalled 1,782,000 net tons compared with 2,197,000 tons in January, 1958, and 2,083,000 in February, 1957.

March 10

△ The Association of American Railroads reported that net income of class I railroads for January, 1958, amounted to $26,000,000 compared with $44,000,000 in January, 1957; operating revenues in January, 1958, were $778,425,405 compared with $855,316,551 in January, 1957.

△ The AISI reports that the operating rate of the steel industry for the week of March 10 is scheduled at 1,442,000 tons. This compares with 1,425,000 tons (52.8 per cent capacity) one week ago and 2,401,000 tons one year ago. Index of production for the week is 89.8.

△ The AISI reports that shipments of finished steel products during January, 1958, totaled 5,215,417 net tons, compared with 5,092,913 in December, 1957, and 7,809,451 tons in January, 1957.

△ According to the AISI production of steel in February, 1958, totaled 5,788,000 net tons, compared with 6,753,902 in January, 1958, and 9,987,206 tons in February, 1957.

March 11

△ The board of directors of August-Thyssen-Huette, A.G. announced it is recommending payment of 9 per cent cash dividend, equal to $70,700,000 for the 1957 fiscal year, compared with 8 per cent dividend last year. The company's board also revealed it had approved the merger of the company and Deutsche Edelstahlwerke to exchange three ATH shares for two DEW shares.

March 12

△ The Commerce Dept. reported that retail store sales in February, 1958, fell to $13,900,000,000, three per cent below January, 1958, and one per cent below February, 1957.

March 13

△ The Agriculture Dept. reported that farm products totaling $2,500,000,000 were exported over the seven-month period ended January 31, 1958, ten per cent below the same period of 1957.

March 14

△ Defense Secretary McElroy disclosed that aircraft contracts totaling $4,600,000,000 will be placed in the first six months of 1958 compared with $3,500,000,000 in the last half of 1957; missile awards are slated at $2,200,000,000 compared with $1,200,000,000 for the final half of 1957.

△ Directors of Lone Star Steel Co. advised that stockholders would be asked to approve a stock increase to 3,249,000 from the present 2,954,000 shares. Sales for 1957 amounted to $95,340,258, earnings $11,329,508 or $3.90 a share compared with sales $88,650,577, income $10,151,363 or $3.50 a share in 1956.

March 17

△ Cramet, Inc., jointly owned by Republic Steel Corp. and the Crane Co. will stop making titanium sponge. The $25,000,000 Federally financed plant at Chattanooga will be turned over to the government.

△ The AISI reports that the operating rate of the steel industry for the week of March 17 is scheduled at 1,415,000 tons. This compares with 1,463,000 tons

(54.2 per cent capacity) one week ago and 2,392,000 tons one year ago. Index of production for the week is 88.1.

Δ Aluminum Company of America reported net sales for 1957 amounted to $869,378,093, net income $75,568,461 or $3.55 per share compared with 1956 sales of $864,416,165, net income of $89,621,033, or $4.24 per share.

Δ Interlake Iron Corp. announced that 1957 net sales and revenues were $108,938,000, earnings $6,894,000 or $3.08 per share; in 1956 net sales and revenues were $110,153,000, net income $8,024,000 or $3.58 a share.

March 18

Δ International Nickel Co. of Canada is curtailing nickel production 1250 tons monthly, about 10 per cent with further cutbacks in prospect unless business shows a quick upturn.

March 19

Δ The Agriculture Dept. predicted that farmers will confine their 1958 plantings to about 335,000,000 acres, about 1,000,000 below 1957.

Δ The International Nickel Company of Canada, Ltd., annual report for 1957 shows net earnings of $86,-141,000 equal to $5.90 per share, compared with $96,296,000 in 1956 equal to $6.50 per share.

March 20

Δ The Aluminum Assn. reported primary aluminum production in the United States during February, 1958, was 121,602 short tons compared with 139,909 short tons in January, 1958, and 119,059 tons in February, 1957.

March 21

Δ Production of passenger cars in the U. S. for the current week is estimated at 85,242 units, compared with 86,441 cars last week and 138,646 cars in the same week of 195.

Δ Industrial Heating Equipment Assn. reports that new orders for industrial furnaces in February, 1958, were $3,684,000, compared with $3,045,000 in January, 1958, and $8,373,000 in February, 1957.

Δ The ARCI reports that deliveries of new domestic freight cars in February, 1958, totaled 5316 compared with 7219 in January, 1958, and 8184 in February, 1957. Orders totaled 294 compared with 401 in January and 6065 in February, 1957. Backlog of cars on order as of March 1 stood at 43,750 cars compared with 48,787 a month earlier, and 111,965 on March 1, 1957.

March 24

Δ The Bureau of Labor Statistics' consumers price index rose to 122.5 per cent of the 1947–49 average in February. This is 0.2 per cent above January, 1958, and 3.5 per cent above February, 1957.

Δ The AISI reports that the operating rate of the steel industry for the week of March 24 is scheduled at 1,363,000 tons. This compares with 1,417,000 tons (52.5 per cent capacity) one week ago and 2,364,000 tons one year ago. Index of production for the week is 84.8.

March 25

Δ Steel scrap prices declined up to $2 a ton.

Δ Great Lakes steel Corp. reported it will suspend steelmaking two to three weeks starting April 4.

Δ Custom smelters increased their price of copper ½¢ to 24¢ per lb following price gains in spot copper in London to 22.18¢ per lb.

Δ The Bureau of Mines, U. S. Department of the Interior, reported that production of iron ore in the United States for December, 1957, totaled 3,257,530 long tons; shipments 1,559,363 long tons; for the year 1957 production totaled 105,386,000 long tons, shipments 104,639,000 long tons.

Δ AISC reported that shipments of fabricated structural steel for February, 1958, were 282,576 tons compared with 316,742 tons in January, 1958, and 318,971 tons in February, 1957. Bookings for February amounted to 185,646 tons compared with 162,158 tons in January, 1958, and 294,141 tons in February, 1957. Backlog on February 28 equaled 2,727,000 tons, a decrease of 36 per cent below February, 1957.

March 26

Δ President Eisenhower proposed a $600,000,000 speedup of government procurement to boost employment and handed Congress an additional $600,000,-000 program of Federal relief for laid-off workers, to extend by 50 per cent the period in which unemployment compensation could be collected.

March 27

Δ Machine tool orders in February totaled $22,800,-000, 18 per cent higher than January, 1958, but 61 per cent under February, 1957.

March 28

Δ Aluminum, Ltd. trimmed its aluminum ingot prices today about 2¢ per lb; price previous to reduction was equal to U. S. producers price, 26¢ lb.

Δ Stockholders of Inland Steel will be asked to authorize issuance of 500,000 new capital shares and waive their pre-emptive rights to them, and approve plan whereby more than 10,000 of the company's 30,000 employes can purchase shares under a program which may run for as long as 10 years.

Δ Some 200,000 German steel workers will vote on a strike for pay increases, which may result in Germany's first steel strike since 1928. The union, representing 180,000, is demanding a 10 per cent pay boost; producers have raised their first 2 per cent offer to 3.7 per cent.

Δ The Bureau of Mines reported that the consumption of scrap during January, 1958, totaled 4,072,000 gross tons, pig iron used was 4,208,000 gross tons; this compares with 4,281,414 tons of scrap and 4,565,635 tons of pig iron in December, 1957.

Δ F. W. Dodge Corp. reports that February, 1958, construction contracts totaled $1,953,422,000, ten per cent below February, 1957.

Δ Latrobe Steel Co. annual report for 1957 showed net profit of $1,311,803 or $3.06 per share compared with net income of $1,348,119 or $3.16 per share for 1956.

Δ Shipments of iron and steel castings during January, 1958, amounted to 1,051,681 short tons compared with 1,045,438 short tons in December, 1957, and 1,468,432 short tons in January, 1957.

March 31

Δ Quarterly Bulletin of Steel Statistics published by United Nations Economic Commission reports ingot steel production in Europe, including USSR, amounted to 176,000,000 net tons compared with 167,000,000 in 1956. 1957 production was USSR 57,000,000 tons, Federal Republic of Germany 27,-500,000, United Kingdom 25,000,000, France 15,-700,000, Italy 7,600,000, Poland 5,900,000, Czechoslovakia 5,800,000 Luxembourg 3,900,000, Saar 3,-900,000, Eastern Zone of Germany 3,700,000, Sweden 2,800,000, Austria 2,800,000, Belgium 7,000,000.

Δ The AISI reports that the operating rate of the steel industry for the week of March 31 is scheduled at 1,298,000 tons. This compares with 1,366,000 tons (50.6 per cent of capacity) one week ago and 2,-319,000 tons one year ago. Index of production for the week is 80.8.

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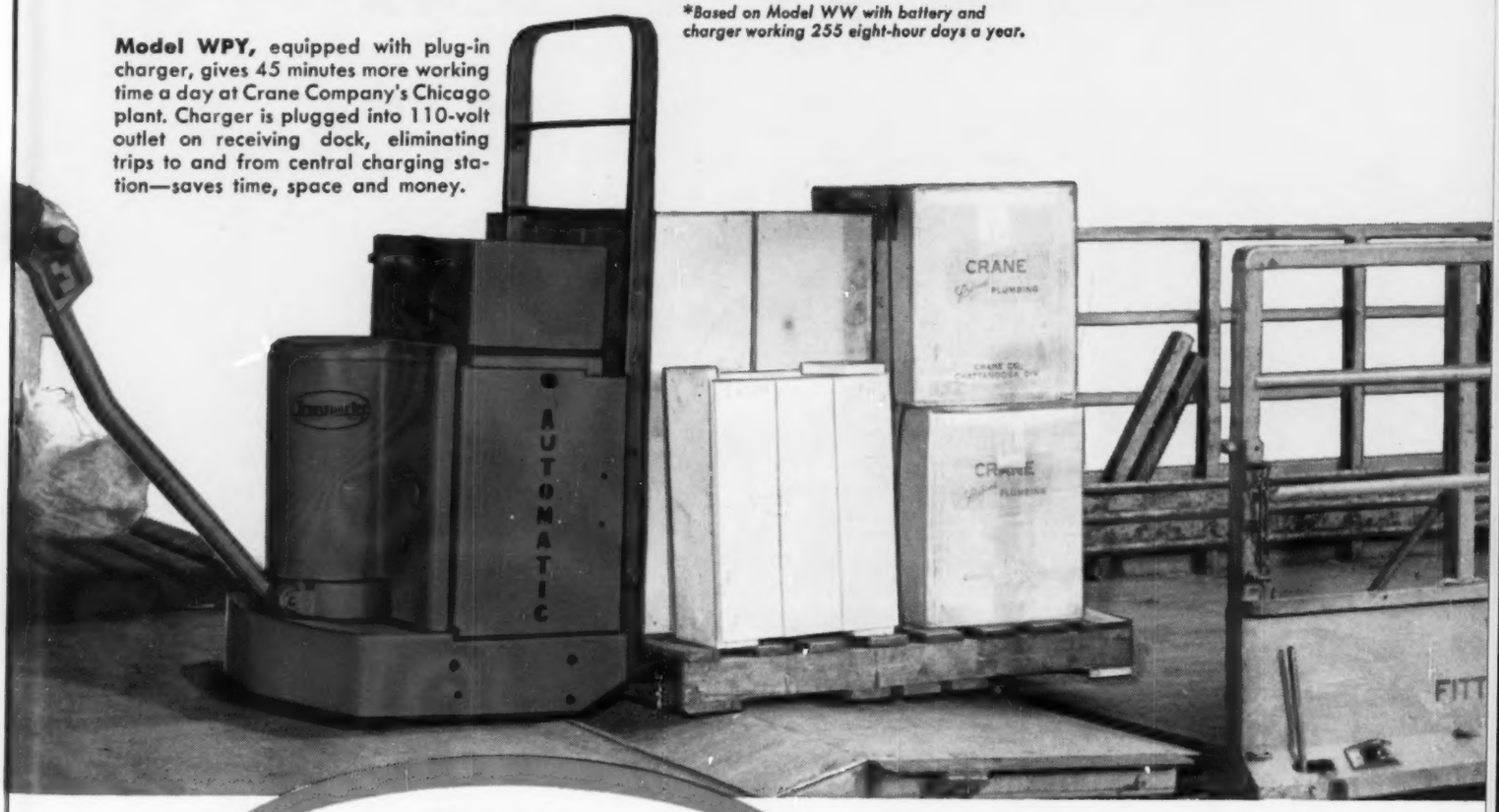

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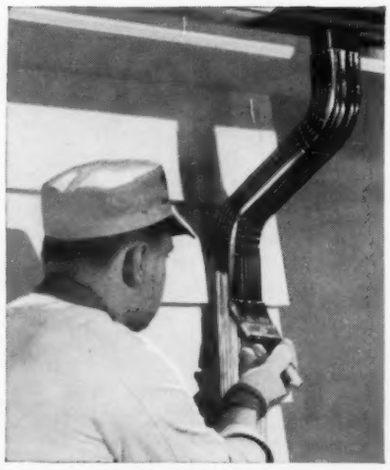

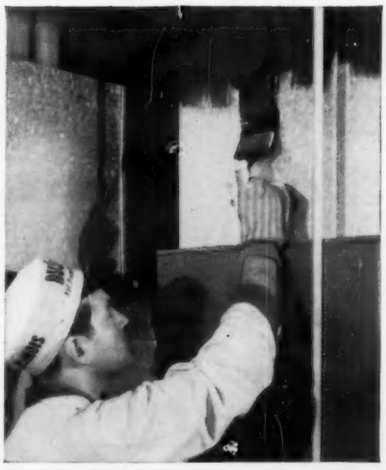

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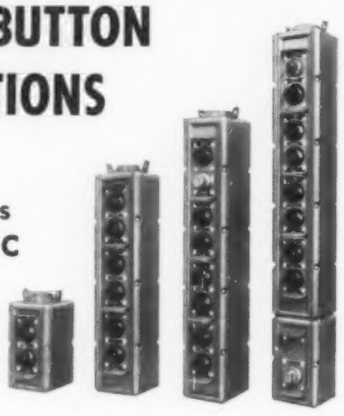

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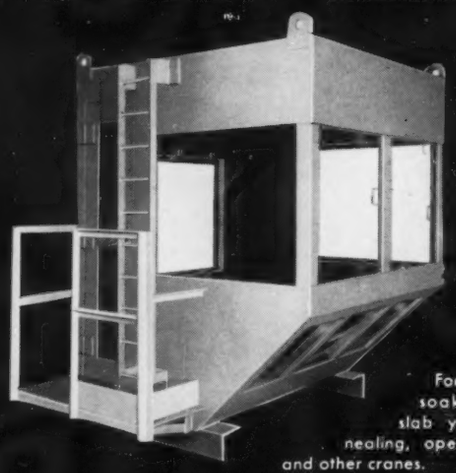

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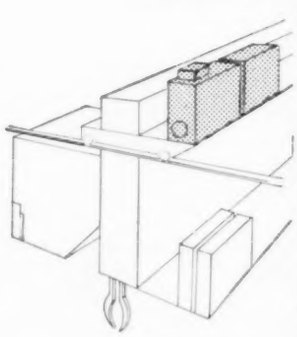

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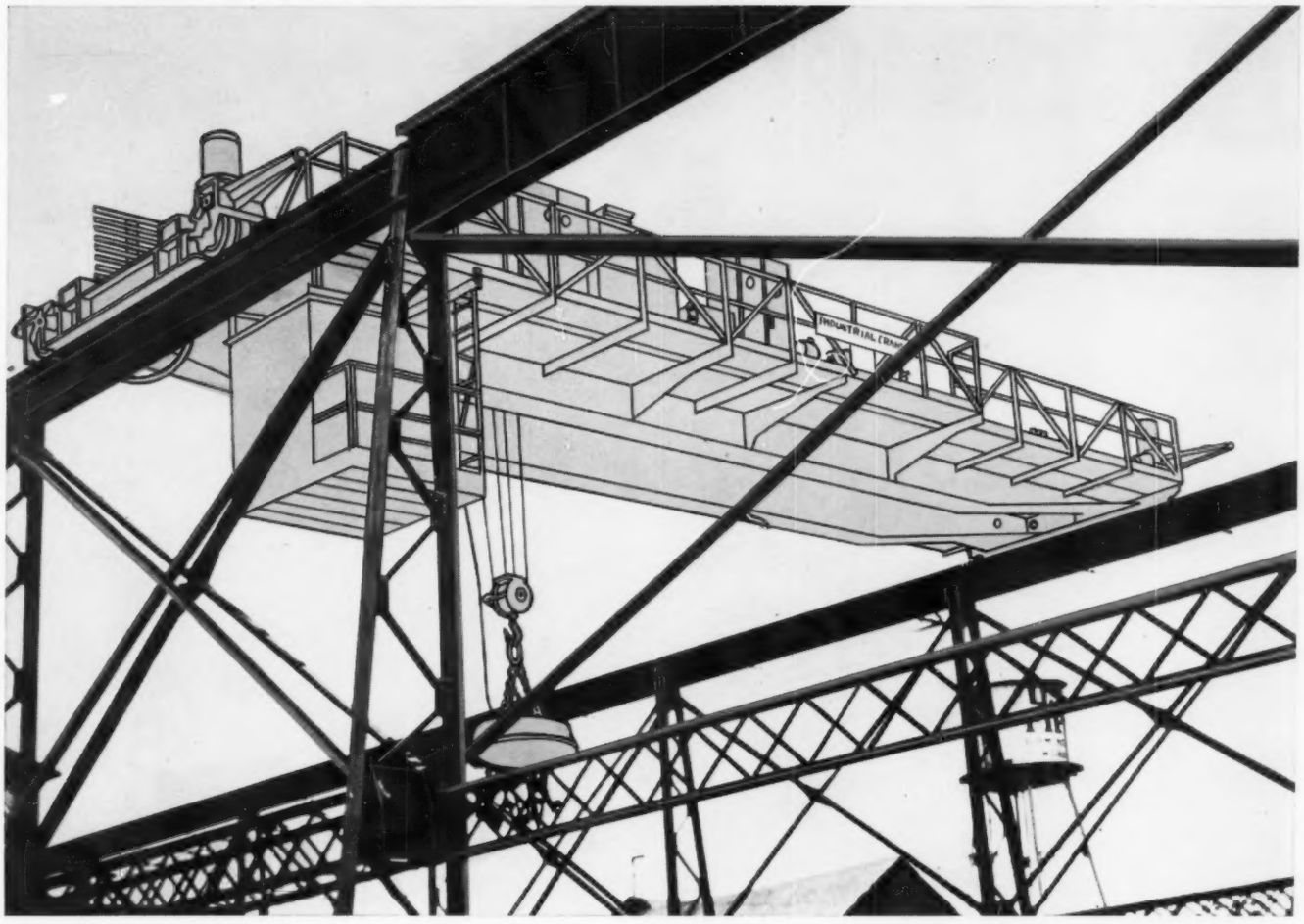

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The new Sylvania tungsten pellets as well as the molybdenum pellets promote substantial savings in vacuum melting production time. There is no need to analyze every batch, and calculations for correct additions of tungsten or molybdenum are simplified. In addition, the convenient size and shape of the pellets facilitate weighing and charging to the melt where they sink and mix quickly.

The dependable supply and stable price of Sylvania tungsten and molybdenum pellets mean that vacuum melting production schedules can be realistically planned on a long-range basis. Alloy price structures can also be maintained without concern for fluctuating raw material costs.

Contact Sylvania's Chemical and Metallurgical Division for further particulars on high-purity tungsten and molybdenum pellets.

Chemical Composition	Typical Composition: Tungsten Pellets	Typical Composition: Molybdenum Pellets
Tungsten, %	99.94	–
Molybdenum, %	0.050	99.85
Iron, %	0.003	0.010
Silicon Dioxide, %	0.003	0.020
Nickel, %	0.002	0.005
Aluminum, %	<0.001	0.005
Calcium, %	<0.001	0.050
Copper, %	<0.001	0.005
Magnesium, %	<0.001	0.050
Manganese, %	–	0.005
Chromium, %	–	0.001
Cobalt, %	–	<0.001
Lead, %	–	<0.001
Tin, %	–	<0.001
Density	14.0 g/cc	8.0 g/cc
Pellet Size	11/16" d x 3/8" h	11/16" d x 1/4" h

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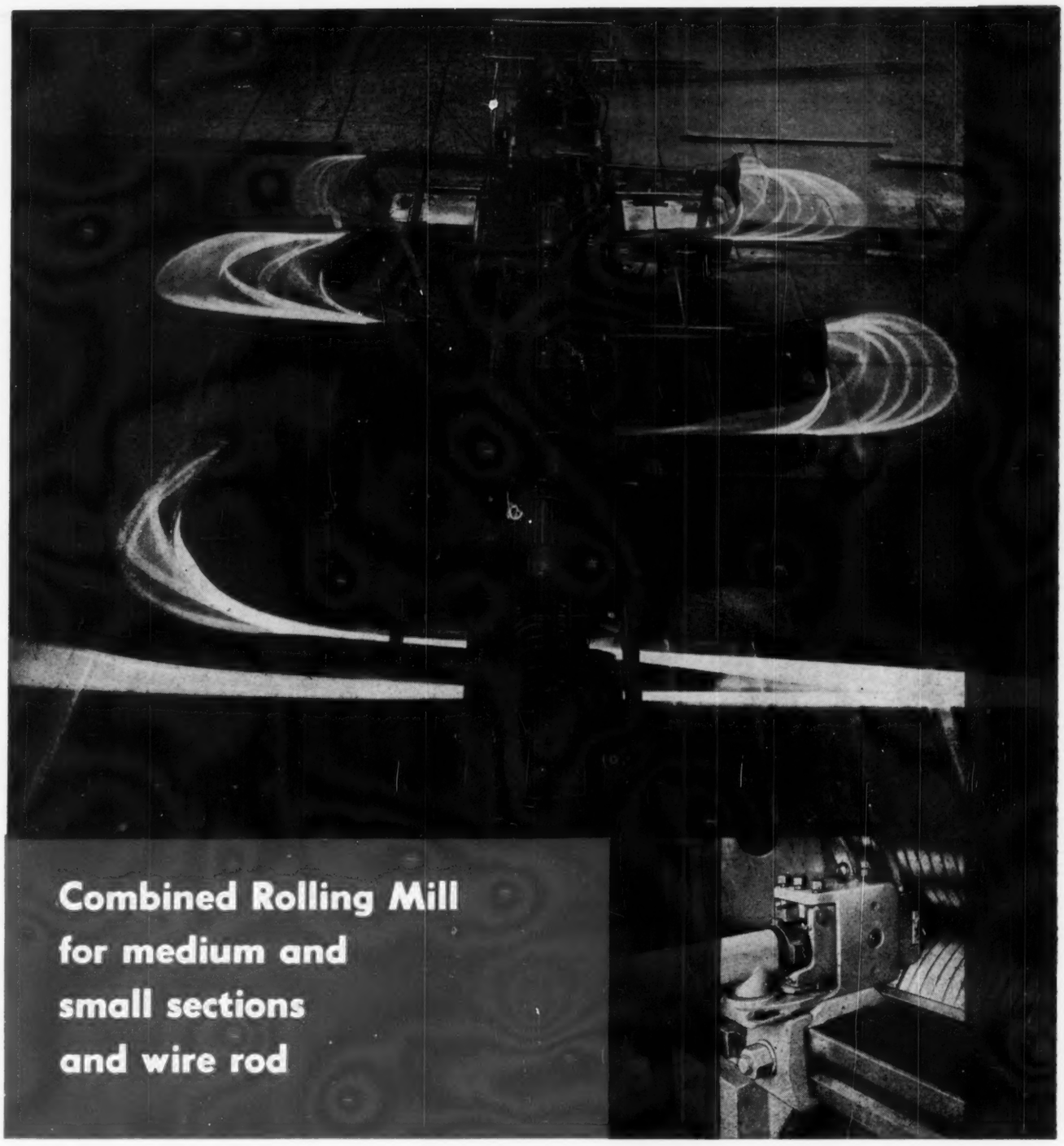

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LOW-PEAK

FUSES

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added to

High Interrupting Capacity

and

Long Time-Lag

Made in all standard sizes above 60 amperes

FUSETRON Low-Peak Fuses are made in all standard sizes above 60 amperes—both 250 and 600 volt ranges.

In 60 amperes and smaller sizes tests show that FUSETRON dual-element fuses have sufficient current limitation to protect circuit and components in all normal cases.

Now you can have a high degree of protection against the thermal and mechanical stresses that heavy fault currents often impose on switches or other circuit components.

FUSETRON Low-Peak Fuses have a current limiting element that cuts off fault current so fast that it cannot build up to a damaging peak.

These new FUSETRON Low-Peak Fuses are built on the same principle as FUSETRON dual-element Fuses. They have:

the same High Interrupting Capacity

the same Time-Lag to hold harmless current surges

PLUS Greater Current Limitation to restrict fault currents to a LOW PEAK

FUSETRON Low-Peak Fuses can be interchanged with FUSETRON dual-element Fuses.

Where their use is required in any part of the electrical system, they can be installed without upsetting proper coordination over the range of useful loads and normal faults.

Hence, their application requires no testing or complicated calculations.

They are designed for use to protect circuits and components that might be damaged by the thermal and mechanical stresses of peak fault currents if other protective devices are used.

If planning new installations, keep FUSETRON Low-Peak Fuses in mind for those locations where peak fault current must be held to a low value.

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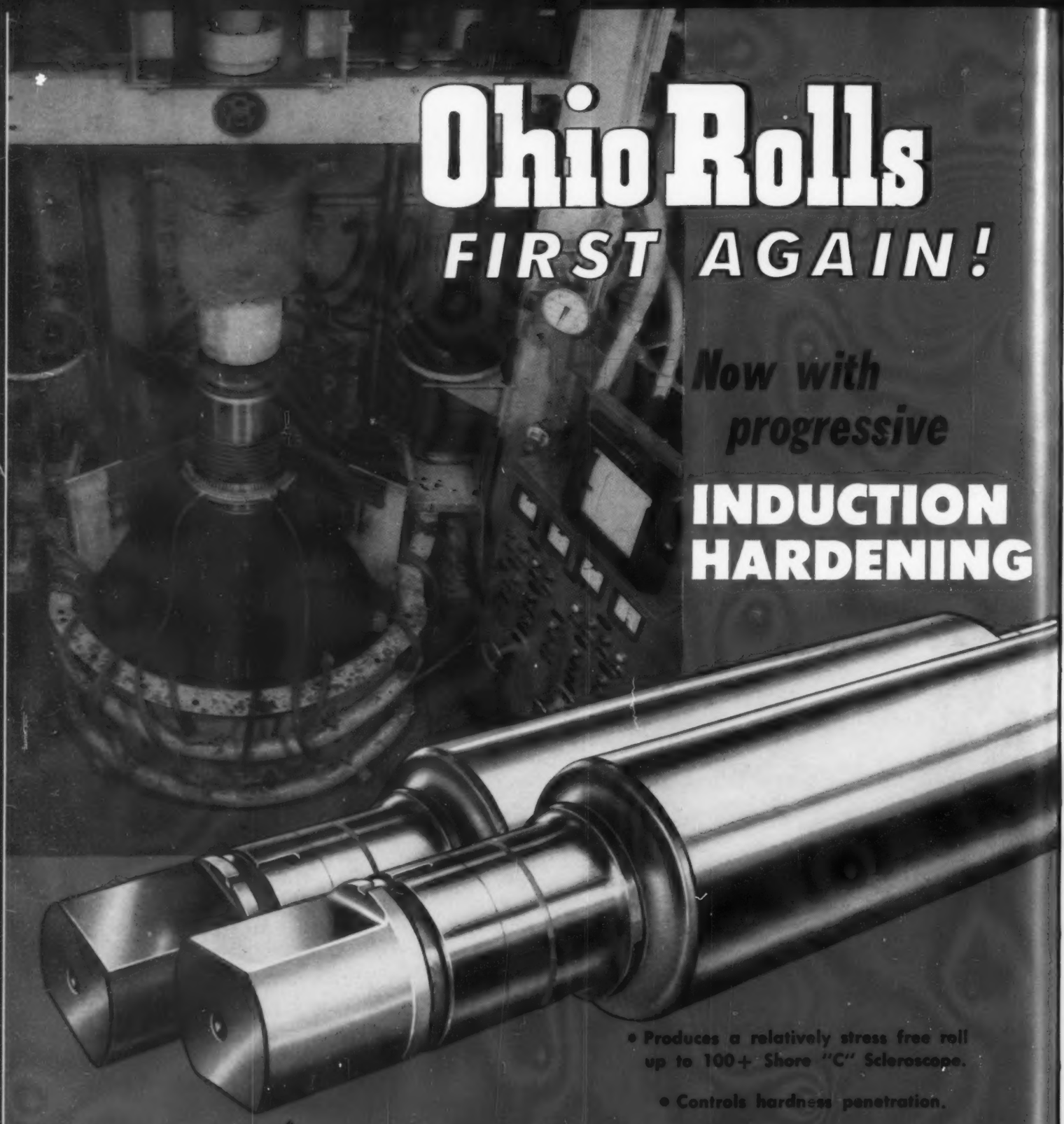
UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.

McGRAW EDISON



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Industry News...

CONSTRUCTION OF NEW SINTERING PLANT BEGINS AT YS&T'S INDIANA HARBOR WORKS

△ The Youngstown Sheet and Tube Co. broke ground March 27 for a new sintering plant in another expansion step at its Indiana Harbor Works.

Completion is scheduled for sometime during the spring of 1959.

Contractor for the new plant is the Arthur G. McKee & Co.

It will have a capacity to produce 4200 net tons of sinter product daily with provisions for doubling the output later with additional equipment.

Among the modern design features of the plant will be ore screening equipment, dust collectors, a television system, automatic mixing, sensing and logging devices for controlling the sinter mixes, scales for weighing the materials conveyed through the operation and an ignition furnace.

All waste gases escaping from the plant will pass through mechanical dust collectors for primary cleaning and then through an electrostatic precipitator for fine cleaning before being released into the atmosphere.

Auxiliary projects to be constructed will include an electric power substation, storage yards, a locker room for employees, office space, chutes for dumping the sinter product at the blast furnaces and a service elevator for the 125-ft high sinter building.

The raw materials for the sinter product will be conveyed on 40 different belts having a total length of 1¾ miles in widths varying from 2 to 4 ft. The sinter machine has a hearth area of 1344 sq ft and consists of a chain of moving grates on wheels that carry the sinter mix.

The new facility will be about 450 ft square and constructed in an area near the blast furnaces and raw material dock on the Steel Plant side of the Indiana Harbor Works. As a replacement for two older outmoded sintering machines, the new unit will have more than four times their daily capacity.

The television system will include a receiver at the master control panel and with monitors located at the discharge end of the sinter machine and at the entrance of the sinter cooler.

The communications system also include a talking relay to various stations in the plant.

JAPANESE FIRM AWARDS CONTRACTS TO MESTA

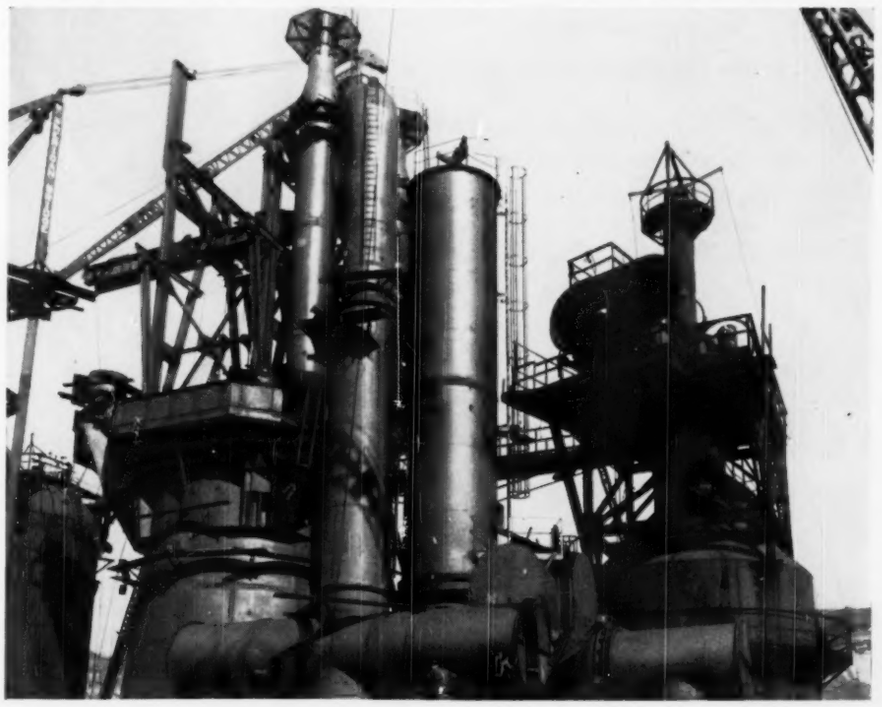
△ Mesta Machine Co. was awarded three contracts by Yawata Iron and Steel Co., Tokyo, Japan, for the design and manufacture of a six stand, four-high finishing train of their 80-in. hot strip mill, a four-high reversing cold reduction mill, and equipment for altering an existing tandem cold mill for rolling sheet products. The installations will be made at the Tobata Works on Kusha Island.

The equipment to be furnished for the 80-in. hot strip mill will include a rotary crop shear, scale breaking stand, six finishing mill stands and two downcoilers. The 80-in. reversing cold mill will be designed to roll coiled strip and sheet steel and will include a mill stand, feed and tension reels and roller leveller for flattening. Their existing five stand, four-high tandem cold mill will be widened and moved to a new site to make a high speed four stand, four-high tandem cold mill with a single stand skin pass mill.

Mesta will also furnish auxiliary

REBUILDING OF J&L FURNACE NEARS COMPLETION

Jones & Laughlin Steel Corp. expects to complete the rebuilding of the No. 2 blast furnace at the Pittsburgh Works in late Spring. The daily output of this furnace, which is being completely rebuilt, will be increased from 850 to 1350 net tons of iron. The hearth of the furnace is being enlarged from 21½ ft in diam to 26½ ft. The furnace, which originally went into production in 1898, has produced more than 12 million net tons of iron. In the photo, structural work has essentially been completed except for the top of the furnace. Workmen currently are lining the inside of the steel shell with heat-resistant brick.



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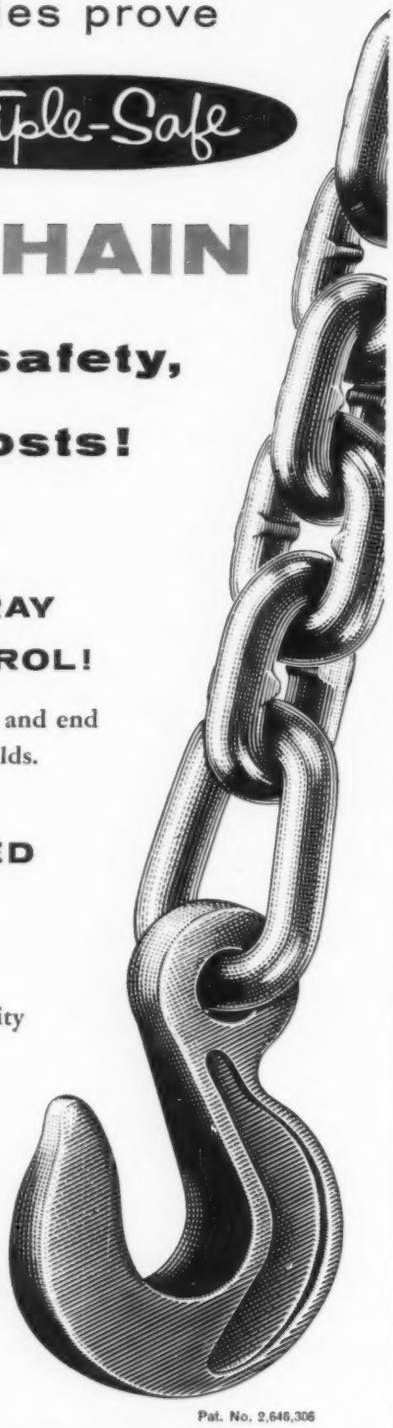
on all popular sizes provides uniformity throughout the sling assembly.

EXCLUSIVE TM PATENTED TAYCO HOOKS!

I-Beam type design plus alloy steel construction mean extra safety!



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S. G. TAYLOR CHAIN CO., INC.
Plants: Box 509, Hammond, Indiana
3505 Smallman St., Pittsburgh 1, Pa.

equipment for the above mills including gear drives, mill pinions, oil bearings, mill rolls, coil handling equipment, roll balance and lubricating systems.

ANNOUNCE FORMATION OF ENGINEERING FIRM

△ A new firm of industrial engineers and consultants, to be known as the Indecon Corp., has been formed, with the main office in Kansas City, Mo., and branch offices in Detroit, Mich., Cleveland, Ohio, and Hammond, Ind. Principals and officers of the new company are John D. Hilburn, president; O. P. Ashurst, executive vice president; Fred W. Niggemyer, vice president; and Robert E. Walton, secretary-treasurer.

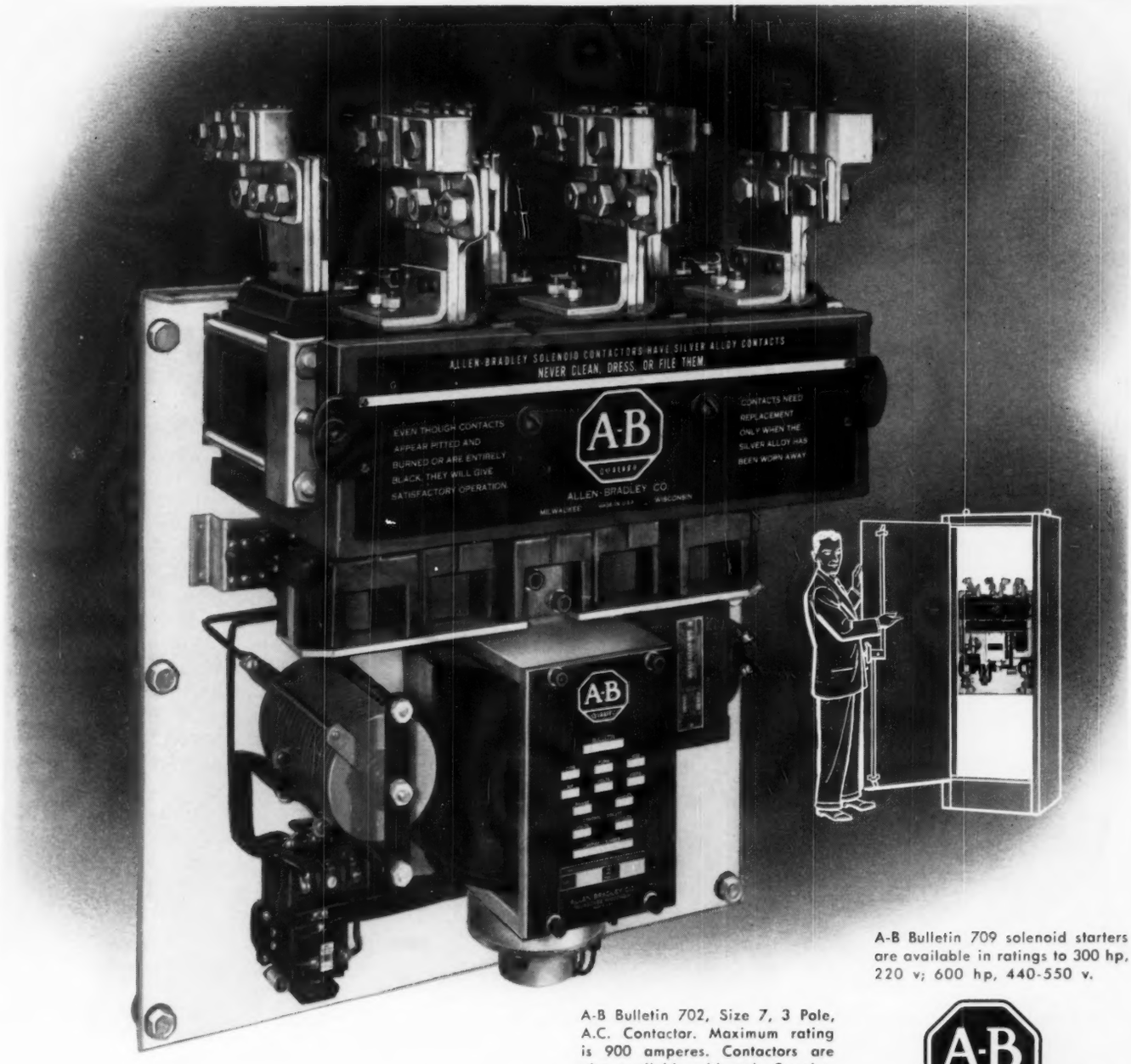
The new firm offers a unique service through its principals and consultants which include industrial engineers, mechanical engineers, electrical and electronic engineers, and architect-engineer groups, both in the United States and abroad. It is organized to take on full responsibility for projects from the earliest planning stage to the final construction and completion of the work.

The following organizations are associated with Indecon Corp.:

- John F. Meissner Engineers, Inc., Chicago, Ill.
- Mackenzie Engineering Co., London, England
- Burns & McDonnell Architects-Engineers, Kansas City, Mo.
- Harley Ellington & Day, Architects-Engineers, Detroit, Mich.
- Fredric Collins, Architect, Gary, Ind.
- Metcalf & Hamilton, Paris, France, New York, N. Y., Kansas City, Mo.
- Long Construction Co., Denver, Colo., Kansas City, Mo.
- Gerometta Construction Co., Gary, Ind.
- Boese-Hilburn Electric Co., Kansas City, Mo., Hammond, Ind., Cleveland, O.

L&N AWARDED CONTRACT BY COLUMBIA-GENEVA

△ The Columbia-Geneva Steel Div. of United States Steel Corp. has awarded contracts to the Leeds & Northrup Co. for open hearth furnace controls.


ALLEN-BRADLEY SOLENOID CONTACTORS HAVE SILVER ALLOY CONTACTS
NEVER CLEAN, DRESS, OR FILE THEM.
EVEN THOUGH CONTACTS APPEAR PITTED AND BURNED OR ARE ENTIRELY BLACK, THEY WILL GIVE SATISFACTORY OPERATION.
CONTACTS NEED REPLACEMENT ONLY WHEN THE SILVER ALLOY HAS BEEN WORN AWAY
A-B
ALLEN-BRADLEY CO.
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A-B Bulletin 709 solenoid starters are available in ratings to 300 hp, 220 v; 600 hp, 440-550 v.

A-B Bulletin 702, Size 7, 3 Pole, A.C. Contactor. Maximum rating is 900 amperes. Contactors are also available with only 2 poles.

A-B QUALITY

SOLENOID SWITCHES in BIG SIZES

Good for millions of operations

Only Allen-Bradley offers the simple solenoid design in BIG switch ratings. From Size 00 up to the husky Size 7, *all* Allen-Bradley switches have only *one* moving part. There are no bearings or pins to corrode and stick . . . no flexible jumpers to wear and break. This is your assurance of more trouble free operations than can logically be expected from more complicated switch designs incorporating more moving parts.

Also, all Allen-Bradley switches have double break, silver alloy contacts that never need service attention. They are always in perfect operating condition.

For BIG switches to handle BIG jobs . . . in the simplest manner possible . . . specify Allen-Bradley.

ALLEN-BRADLEY Quality MOTOR CONTROL | ALLEN-BRADLEY CO., 1343 S. FIRST ST., MILWAUKEE 4, WIS.
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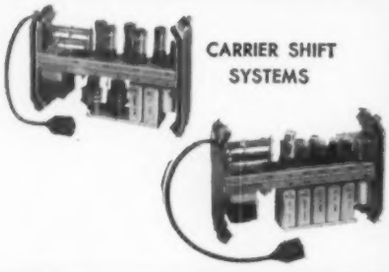
Femco

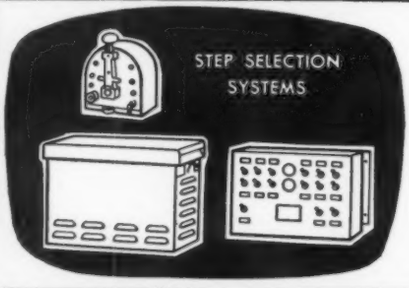
CONTROL SYSTEMS

FOR MODERN INDUSTRY

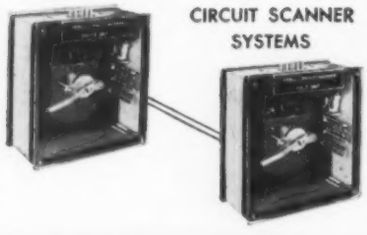
with standard components, we can provide control and indication for many purposes.



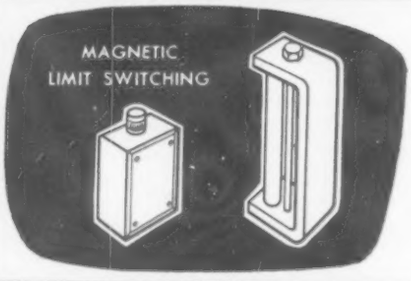
CARRIER SHIFT SYSTEMS



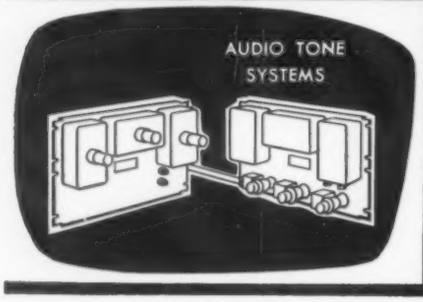
STEP SELECTION SYSTEMS



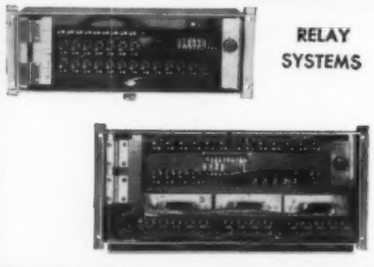
CIRCUIT SCANNER SYSTEMS



MAGNETIC LIMIT SWITCHING



AUDIO TONE SYSTEMS



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Let a Femco sales engineer help solve your problem.

UNderhill 3-3200 Femco, Inc. IRWIN, PA.

COMMUNICATION • Electronic Engineers • AUTOMATION

The controls will be used to improve the fuel efficiency of ten open hearth furnaces at Geneva Works, and will also similarly equip five furnaces at the Pittsburg, Calif., plant.

LINDE OXYGEN SUPPLIES PITTSBURGH STEEL

△ A new oxygen-producing plant serving Pittsburgh Steel Co.'s Monessen Works is now "on-stream," according to a joint announcement from Linde Co., Division of Union Carbide Corp., and Pittsburgh Steel.

W. M. Haile, President of Linde, said the new plant is capable of supplying 140 tons of high- and low-purity oxygen a day. Located on property leased from Pittsburgh Steel, the plant was built, is owned and will be operated by Linde.

Approximately 126 tons of low-purity oxygen (95 per cent pure) will be used daily in the 12 open hearth furnaces to improve and speed the steel-melting process. About 14 tons of high-purity oxygen (above 99.5 per cent pure) will be available for cutting, scarfing and other related mill operations.

Formerly, oxygen used at Monessen Works had to be transported from other Linde plants in western Pennsylvania. But with Pittsburgh Steel's recent expansion in ingot capacity, production of oxygen at the point of its use became necessary.

Use of oxygen in the open hearths increases the rate at which carbon is burned out of the molten metal. Since the amount of fuel introduced is increased, time required to make steel is reduced and capacity of the furnace, in effect is enlarged and production increased.

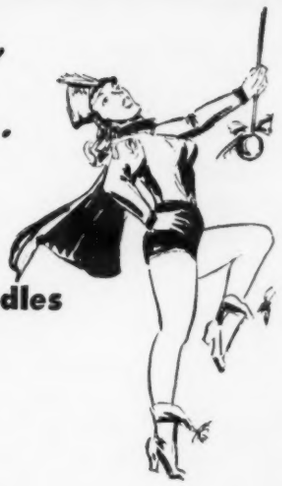
ADD ELECTRIC FURNACE AT DUQUESNE WORKS

△ The electric furnace shop at United States Steel's Duquesne Works is being expanded to accommodate a new electric furnace, general superintendent J. W. Price, Jr., has announced.

Steelwork for additions to both ends of the shop is being erected by the corporation's American Bridge Div., Mr. Price said, so that an 83-ton electric furnace and auxiliary equipment may be installed.

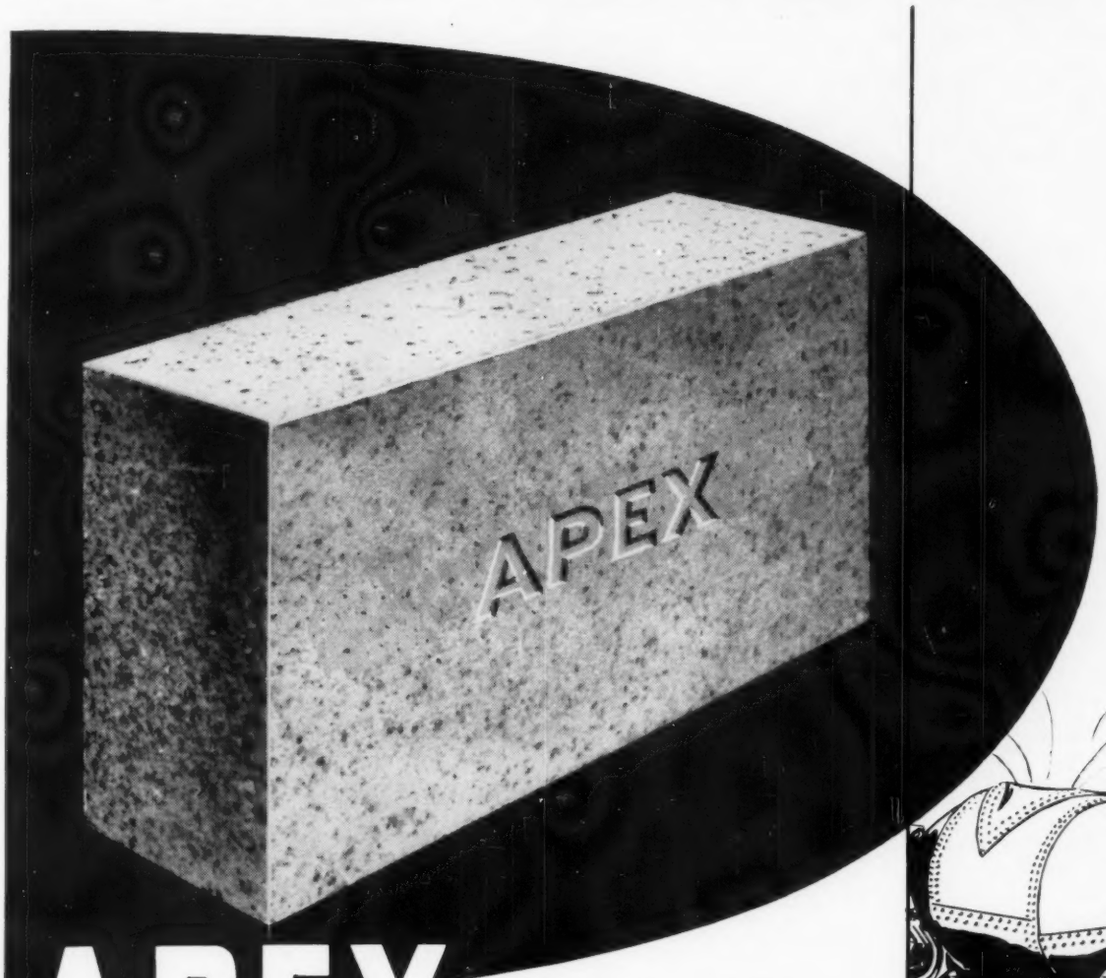
The new furnace, which will be

"Get on the Band Wagon..."



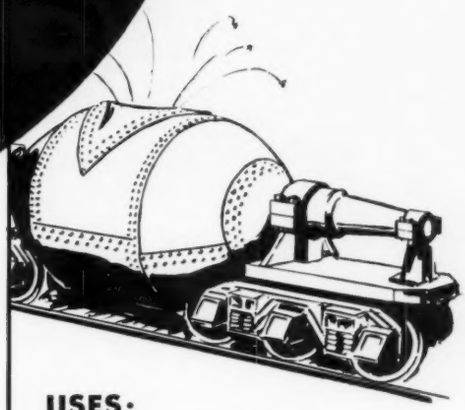
with WALSH APEX Fire Brick

Assures Record Tonnages for your Hot Metal Torpedo Type Ladles



APEX SUPER DUTY FIRE BRICK

Last word in high bulk density, low porosity, high heat transfer and maximum resistance to slag penetration and metal wash, Apex offers greater value per dollar invested. Isn't this the kind of economical service you want? Write for details.



USES:

Designed specifically for lining closed and semi-closed hot metal torpedo type ladles, hot metal mixers and for checkering open hearths and hot blast stoves.

WALSH REFRACTORIES CORPORATION — America's Best Clays

WALSH REFRACTORIES CORPORATION

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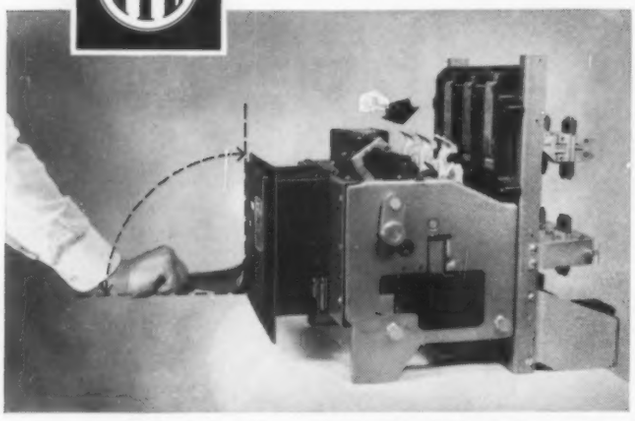
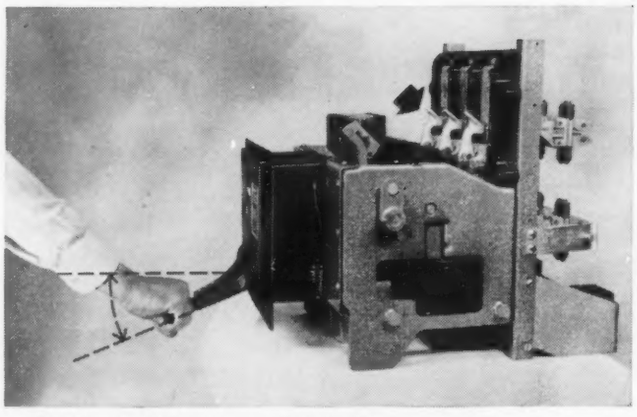
K-LINE LOW VOLTAGE SWITCHGEAR





Only I-T-E has manual quick-make operation available in 225 through 1600 amp rating

Only handle moves. Contacts are static during first 90% of pulldown handle travel. In this picture, arc chutes are removed.

Too fast for the eye. When stored energy mechanism passes crossover point, energy is released to close contacts within 5 cycles.

Only I-T-E has doors closed in all positions while racking

With breaker connected. Both power and control separable contacts are engaged.

In test position. Power contacts disconnected —control contacts connected.

Completely disconnected. Both power and control contacts fully disconnected.

Quick-make, manually charged closing feature and drawout with doors closed provide maximum safety for operator and circuit breaker

You can't tease and burn the contacts of the new quick-make K-Line of circuit breakers—the closing action is fast and positive. An ingenious stored energy mechanism does the job. It stores energy in the first 90% of the pulldown handle travel, releases it in the last 10%. Not until the crossover point is reached do the contacts move. And it closes in only 5 cycles—provides uniform closure every time. *More important, it is the only manually charged stored energy circuit breaker available that will close and latch against its short-time rating.* This means greater safety for the operator, less maintenance, and longer contact life.

You don't have to open the door to move the circuit breaker to test or disconnected position. The crank which operates the simple drawout mechanism fits into the escutcheon through a lift shutter. The shutter cannot be lifted while the breaker is closed. The breaker cannot be closed while the shutter is lifted. This means more than greater safety—you can forget the dirt problem; the nuisance of open doors impeding aisle travel; the risk of circuit breaker damage from exposure, even when completely out of service.

Bulletin 6004-C gives complete information about the new and safer I-T-E K-Line of low voltage switchgear. Contact your nearest I-T-E sales office for a copy. Or write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY

PHILADELPHIA, PENNSYLVANIA

fabricated and installed by American Bridge, will be the fifth furnace in the shop and the third with an 83-ton per-heat capacity. It will increase the annual productive capacity of the shop by 75,000 tons to a new total of 294,000 tons per year.

This additional capacity for producing electric furnace steels—stainless and alloy—is tied in closely with the corporation's increased stainless steel rolling capacity at the Vandergrift Plant of Irvin Works, where a new cold strip mill has been installed.

In addition, Duquesne Works will be able to produce more stainless and alloy steel ingots destined to be hot forged and machined at Homestead District Works to produce generator shafts, nuclear reactor vessel parts and other critical-application forgings.

Along with the new swing-top furnace, the electric furnace shop expansion project includes related pouring and charging facilities, and miscellaneous conditioning, finishing and testing equipment.

Installed will be overhead-track cranes, ladles and ladle stands, additional slag pots and cars and charging equipment.

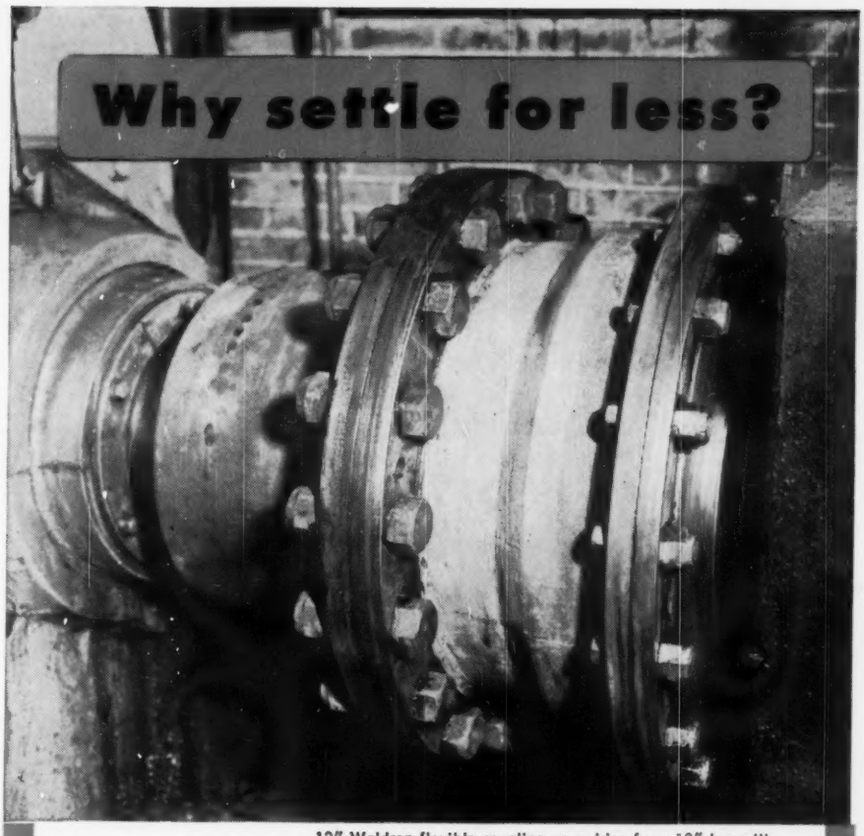
Service lines carrying gas, air, oxygen, steam and water to the electric furnace shop will be enlarged or extended, as will electrical installations, narrow and standard-gage railroad track, roadways and sewers.

Scheduled for completion this summer, the electric furnace project represents another important phase of U. S. Steel's current expansion and improvement program in the Pittsburgh district.

AUSTRALIAN BEARING PLANT NEAR PRODUCTION

△ Australian Timken Proprietary Limited, a wholly owned subsidiary of The Timken Roller Bearing Co., expects to have one of its production lines in its new plant operating after June of this year. The plant will produce the first tapered roller bearings to be made in Australia.

Forming of the subsidiary was announced by Timken in July, 1957, and construction of the new plant started in September, in Ballarat, Victoria, Australia. Initial plans



12" Waldron flexible coupling on a drive for a 12" bar mill.

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WALDRON

Gear Couplings

you get

STRENGTH —Hubs and cover sleeves for sizes 1¼A tnrough 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

RELIABILITY —There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is at the lowest possible diameter where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

SERVICE —Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

▶ Ask for Catalog 57

JOHN **WALDRON** CORP.

NEW BRUNSWICK, NEW JERSEY

Representatives In Principal Cities

called for production capacity of 600,000 bearings a year, but Australian Timken is increasing that capacity by nearly 67 per cent.

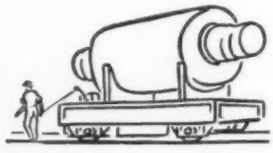
U. S. STEEL SUPPLY TO OPEN ALA. WAREHOUSE

△ The U. S. Steel Supply Div. of United States Steel Corp. will begin a steel warehousing operation in Birmingham, Ala., on May 1, it was announced by John H. Morava, president of the Supply Div.

The opening of facilities in Birmingham will mark the entry into the south of U. S. Steel Supply. The division will utilize the former strapping products warehouse of Gerrard Steel Strapping and the former wire rope and stainless steel warehouse of United States Steel's Tennessee Coal & Iron Div. Gerrard, formerly a separate division of United States Steel, recently became a part of the Supply Div.

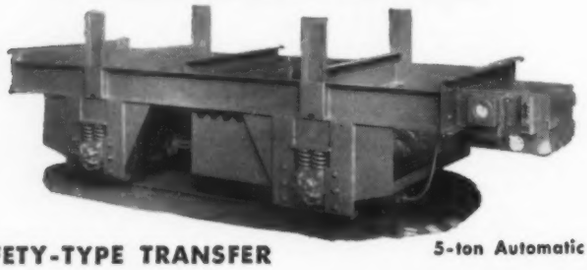
A complete warehousing service, including all general line steel products, will be available through the combined facilities.

HANDLES THE BIG LOADS WITH BIG SAVINGS



100-ton Battery Operated

ATLAS *Safety Type* TRANSFERS



5-ton Automatic Controlled

ATLAS SAFETY-TYPE TRANSFER CARS can be provided in almost any capacity for storage battery, diesel or gas-electric, or cable reel service.

They are safe because there is only one control lever, and the car moves only when the operator holds the lever.

Request "Walk-Along" Bulletin 1283.

ATLAS CAR & MFG. CO.
1100 IVANHOE ROAD
CLEVELAND 10, OHIO

ENGINEERS AND MANUFACTURERS SINCE 1896

GEAR FIRM COMPLETES EXPANSION PROGRAM

△ Illinois Gear & Machine Co., announces the completion of the new plant expansion program at the company's South Works, Chicago, Ill. The principal feature of the program is the heavy machinery building, which has a double crane with a lifting capacity of more than 50 tons.

The building houses special, heavy gear manufacturing equipment, built to the company's specific requirements for manufacturing gears of unusual size and accuracy. The largest and most modern spiral bevel gear generating equipment has been installed to produce precision gears up to 94 in. diam., 0.625 D.P. (5.5 in. C.P. stub) and 13 in. face width. Gears of this type can transmit loads up to 5000 hp.

J&L TO MANUFACTURE STAINLESS STEEL WIRE

△ The Stainless Steel Div. of Jones & Laughlin Steel Corp. begins the manufacture of stainless steel wire shortly when its new wire mill goes into operation at Detroit, Mich.

The mill will produce stainless wire in sizes ranging from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. in coils or straight lengths. Four finishes will be available: cold drawn; copper-coated and cold drawn; special non-metall coatings; and centerless ground.

J&L stainless wire will be offered in the standard types of both the 300 and 400 stainless steel grades.

Among the many applications of the stainless wire to be produced at J&L's new mill are cold heading wire, spring wire, welding wire in smaller sizes, weaving wire, forming wire, rope wire, belt wire, and slide forming wire.

The wire will be sold through five Stainless Steel Div. sales offices located at Detroit, Chicago, Cleveland, Los Angeles, and Newark, N.J.

The new half-million-dollar wire mill is an integral part of J&L Stainless Division's main plant and offices at Warren, Mich. Construction of the new mill began in March, 1957.

Coils and rods of stainless steel from J&L's recently completed bar mill at Detroit will serve as the incoming material for the immediately adjacent wire mill, which will

TRANTINYL GUIDES THE STEEL INDUSTRY

"TRANTINYL" offers a quarter-century of metallurgical experience. "TRANTINYL" patented alloys were developed to function in specific operations where guides are required to resist wear and abrasion. Users of "TRANTINYL" alloys are astounded at the tonnage rolled over one set of guides.

Join the many satisfied users of "TRANTINYL."

ROLLING MILLS:
bar, hoop, strip, shape mill guides; and rollers.

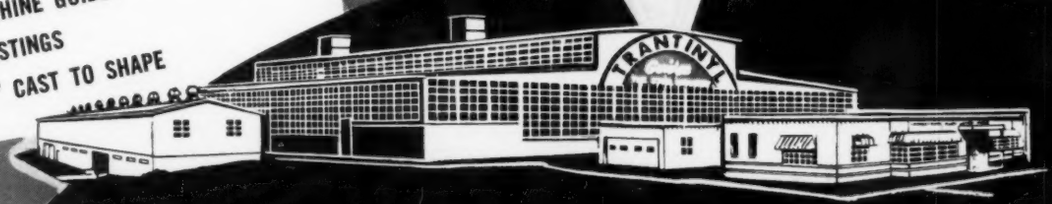
SEAMLESS TUBE MILLS:
guide shoes, rolling mill plugs and rolls, piercer points, etc.

ELECTRIC WELD TUBE MILL:
forming rolls, planishing rolls, tool holders, etc.

STRAIGHTENING MACHINE GUIDES

HEAT RESISTING CASTINGS

"TRANTINYL No. 1" CAST TO SHAPE



Youngstown Alloy Casting Corporation

Youngstown, Ohio

G-10

Ceramic engineers examine new HKP Silica Brick roof.

20% LONGER ROOF LIFE with HKP Silica Brick

A large western steel company reports that installation of HKP Super Duty Silica Brick increased their open hearth roof life by 20% over a one-year period. And in comparison with the next best refractory, HKP Silica Brick averaged 13% more heats to the first patch. This is a remarkable record—another instance where Porter products help keep the refractory cost per ton down.

THE REASON: HKP Silica Brick is composed of carefully selected raw materials, and is under strict quality control through every step of its manufacture. The result is a stable product with uniform characteristics and consistent quality. Users depend on it to perform with a minimum of variation in service.

For further information write to *Laclede-Christy Works, Refractories Division, H. K. Porter Company, Inc., St. Louis 10, Missouri. In Canada, H. K. Porter Company (Canada) Ltd., Guelph, Ont.*

H. K. PORTER COMPANY, INC.
REFRACTORIES DIVISION

have the most modern equipment in use today for the manufacture of stainless steel wire.

The contractor for J&L's new wire mill is Barton-Malow Construction Co. of Detroit.

Jones & Laughlin is also constructing a stainless sheet and strip mill at Louisville, Ohio, which is scheduled to begin operation during the third quarter of this year.

TO IMPROVE WIDE PLATE FACILITIES IN CHICAGO

△ United States Steel Corp. is planning major improvements to its present wide plate manufacturing facilities in the Chicago District, it was announced by C. F. Hood, president.

Mr. Hood said that engineering work is being undertaken looking toward the installation of facilities which will permit expansion of wide plate production together with improved quality and service to customers served by the Gary Works in the Chicago District.

This is in addition to improvements in plate mill facilities in the Chicago District announced in 1956. Most of these facilities, both at Gary and South Works, are installed or nearing completion.

As plans and engineering studies progress on the new improvements, Mr. Hood said further announcements will clarify the program presently under consideration.

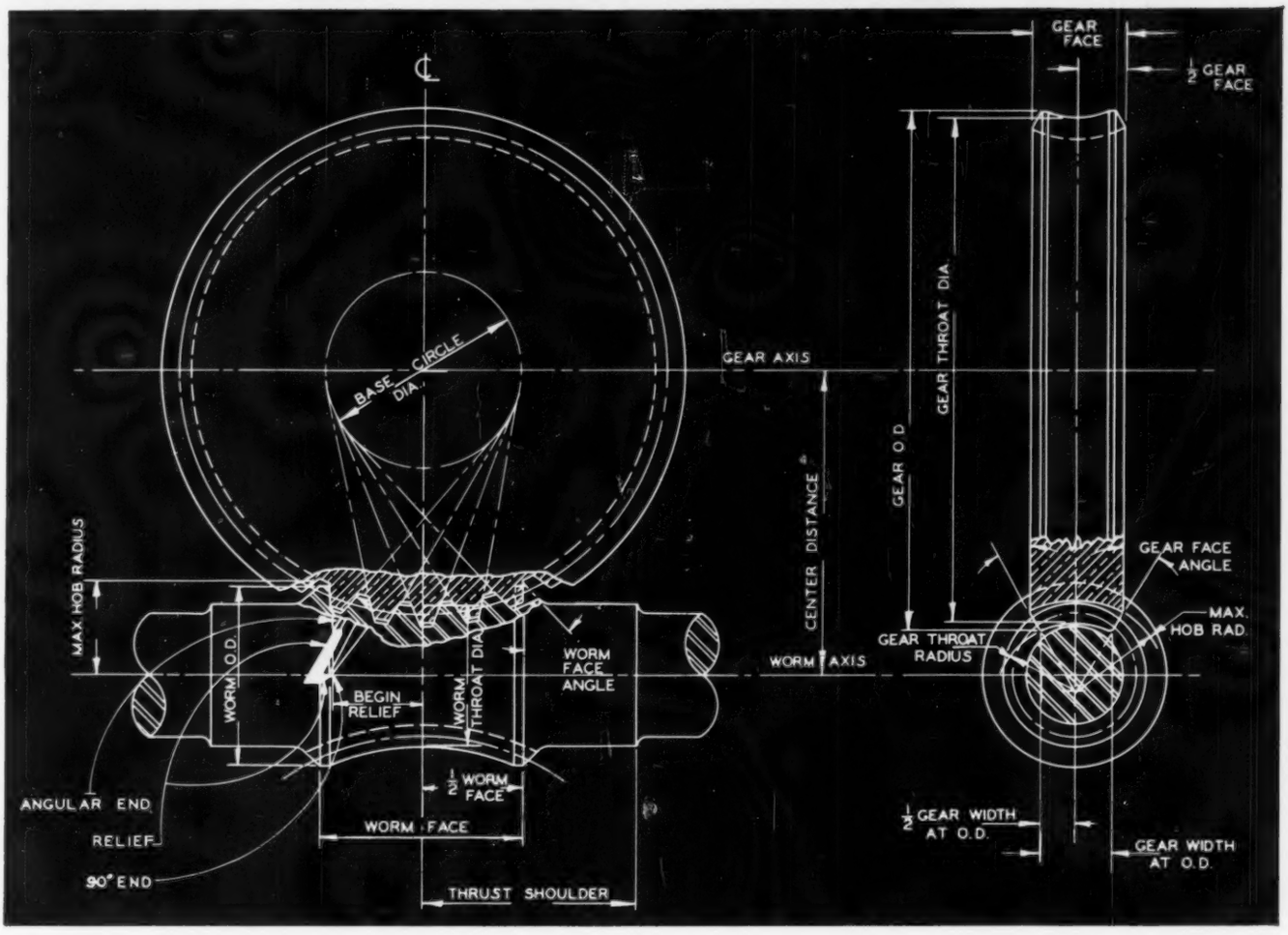
REFRACTORY FIRM ADDS FIREBRICK TO ITS LINE

△ The Refractory & Insulation Corp. has added fireclay firebrick to its varied line of bonding mortars, castables and insulating materials. For the past thirty years, R&I was known as primarily a manufacturer of specialty products. The brick will conform with all the refractory standards required by industry.

Meetings

△ The Tenth National Engineering Conference to be sponsored by the American Institute of Steel Construction, will be held at the Chase-Park Plaza Hotels on Thursday and Friday, April 17 and 18.

WORM GEAR DESIGN . . . *Bulletin #200*



Bulletin 200 has 20 pages crammed with 38 formulae, such as the Formula for Class I AGMA Horsepower Rating:

$$P = K_s K_m K_v \frac{n}{mg}$$

Step-by-step instructions, with typical examples, enable you to quickly determine the size worm gearset you need to meet any horsepower and service required.

You can calculate the bearing loads and sizes needed for the worm and gear shafts.

You can check the worm root stress and gear tooth stress.

Efficiency is charted against helix angle with modifications for required speed so you can quickly determine efficiency.

One quick look at the drawing above will convince even the uninitiated that no other worm gearset has so many teeth in contact. No other worm gearset is so simple to design and rate. No other worm gearset will carry so much load in so little space with so little weight.

Now, Bulletin 200 provides complete design and application data on space-saving double-enveloping worm gearing. Ask for it without obligation.

CONE-DRIVE GEARS DIVISION MICHIGAN TOOL COMPANY

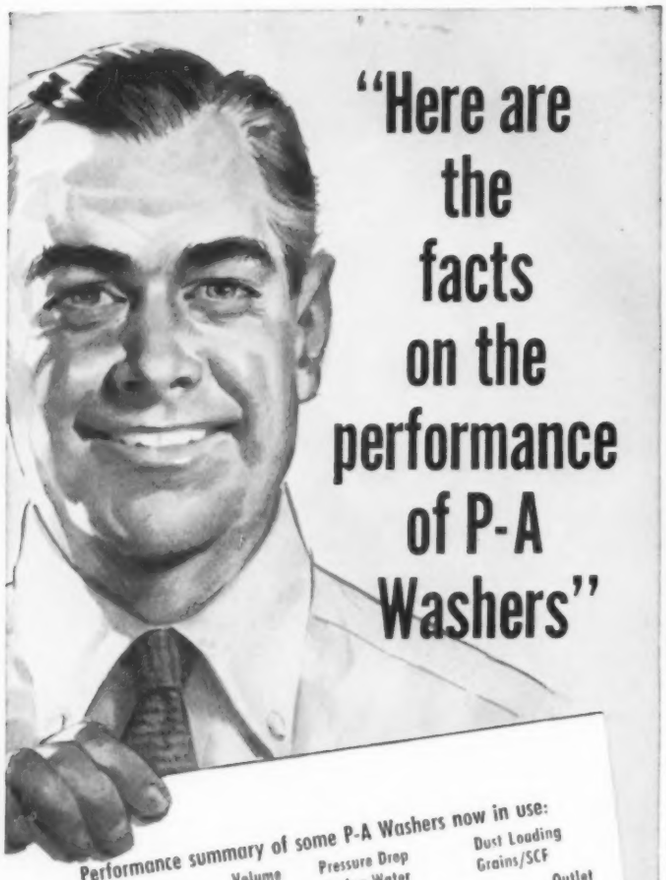
7171 E. McNichols Road • Detroit 12, Michigan • Telephone: TWinbrook 1-3111

DOUBLE-ENVELOPING WORM GEARSETS

DOUBLE-ENVELOPING WORM GEAR SPEED REDUCERS

DOUBLE REDUCTION WORM GEAR SPEED REDUCERS

DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS



"Here are the facts on the performance of P-A Washers"

Performance summary of some P-A Washers now in use:

Installation	Years Operated	Volume SCFM	Pressure Drop Inches Water	Dust Loading Grains/SCF Inlet	Outlet
A	4	78,000	30	3-19.0	.01-.04
B	3½	78,000	30	2-3	.02-.08
C	3	85,000	30-40	2-3	.01-.03
D	3	45,000	30	2	.02-.03
E	½	75,000	50	—	.02
F*	½	26,000	12	5	.10
G*	½	26,000	12	5	.10
H	½	90,000	29	—	.04

*Two units in parallel on one furnace. Lower efficiency due to lower available top pressure

These actual performance figures reflect the highly efficient operation of the Pease-Anthony washer. This venturi scrubber puts your full top pressure to work cleaning the gas. No secondary cleaner required for most installations. Present users report no maintenance problems. If you have a blast furnace scheduled for construction or rebuilding, plan now for P-A Venturi installation. Capacities up to 150,000 SCFM. Write for bulletin M-103.

CHEMICO
P-A GAS SCRUBBERS

CHEMICAL CONSTRUCTION CORPORATION

A Subsidiary of Electric Bond and Share Company

525 West 43rd Street, New York 36, New York
Telephone LOngacre 4-9400

Technical Representatives Throughout The World
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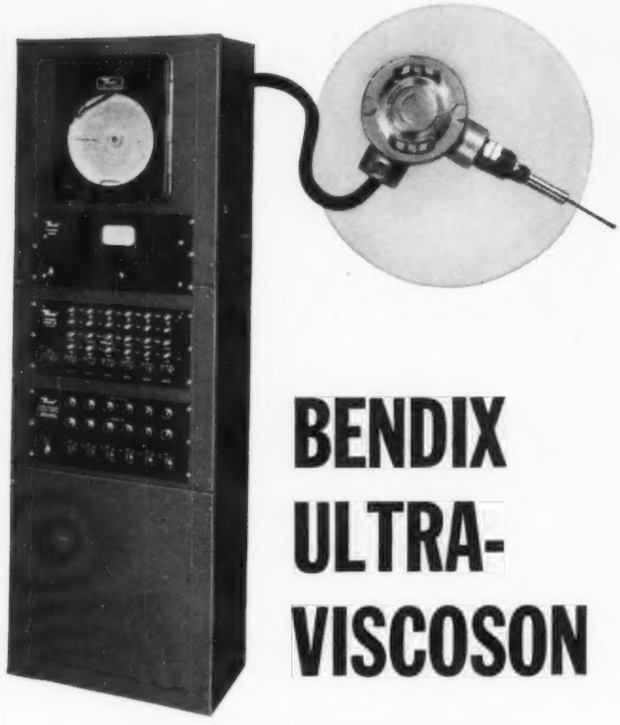
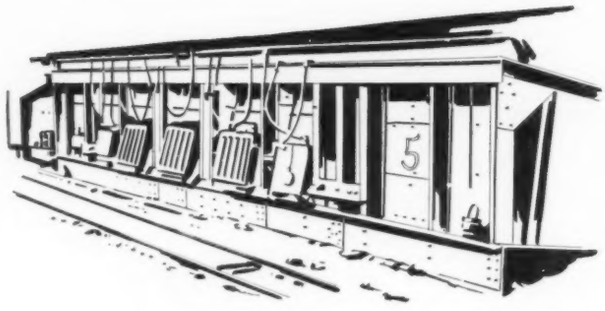


BENDIX ULTRA-VISCOSON

Automatically controls fuel viscosity for highest combustion efficiency



Bendix Ultra-Viscoson* can save you money by reducing heating time, furnace maintenance and fuel costs. Viscosity is a big problem in obtaining proper atomization of fuels and uniform flame characteristics for open-hearth furnaces, steam generating power plants, and glass-melt furnaces. BLOWOUTS, SPUTTERING, and POOR COMBUSTION can all result from too low or too high a viscosity.

Bendix Ultra-Viscoson eliminates these problems by automatically controlling the flow of heat exchange fluid to the pre-heater. Precise control of viscosity is maintained by continuously adjusting temperatures.

For complete information, contact the Cincinnati Division, Dept. 380, 3130 Wasson Road, Cincinnati 8, Ohio. *REG. U.S. PAT. OFF.

Export Sales: Bendix International Div., 205 E. 42nd St., New York 17, N.Y.
Canada: Computing Devices of Canada, Ltd., Box 508, Ottawa 4, Ontario

Cincinnati Division

Bendix AVIATION CORPORATION

News and Notes on...

Good Packing Practice

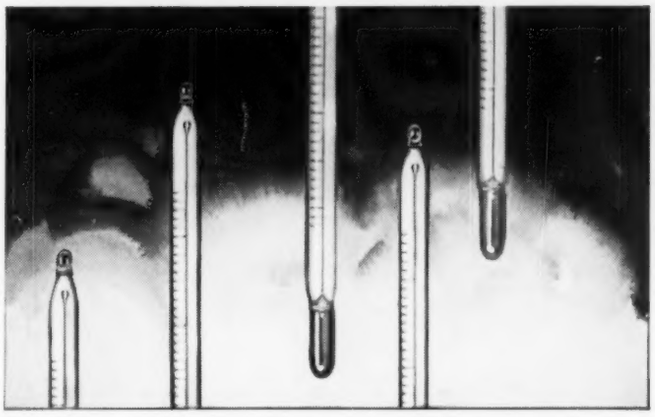
JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: High Operating Temperatures

Question:

What sealing materials are currently available that will match conditions brought about by higher and higher operating temperatures?



Condition 1

FOR LASTING VALVE SEALS AGAINST SUPER-HEATED STEAM AND DRY GASES

Designed to meet today's demand for a packing that will maintain a tight seal against steam and dry gases on valves working at line temperatures up to 1200F, J-M High-Temperature Valve Stem Packing, Style 397, offers the three-way protection of a heat-resistant plastic core, asbestos yarn, and Inconel wire reinforcement. For lasting protection of valve stems during storage, this efficient packing is now available with J-M No. 9 corrosion inhibitor.

Condition 2

FOR UTILITY SEALING IN GENERAL APPLICATIONS REQUIRING HEAT AND FLAME RESISTANCE

Wherever your operation calls for a utility gasketing material that withstands both heat and flame, specify J-M Asbestos Rope, Style 4200. Made of 99% pure asbestos, this material can take temperatures far in excess of other grades of rope. You'll find it a handy, reliable gasket for sealing joints between furnace doors and brickwork, boiler expansion joints, blast furnace connections, ingot moulds, and countless other uses. Ask for information about J-M Style 4200 Asbestos Rope.

Condition 3

FOR FLANGES WORKING AT TEMPERATURES TO 1600F AND HIGHER

Elevated temperatures are efficiently sealed using J-M Goetze V-Tite Gaskets. Used in flanges grooved for ring joint gaskets. Materials are available for service ranging upwards of 1600F. Controlled hardening assures correct flow of material at low bolt stress. Temperature range —320F to +1600F and higher.

Condition 4

FOR PACKING PROBLEMS IN ANY TEMPERATURE RANGE

Your Johns-Manville field representative is a trained specialist in packing problems of all types. He's located near you, to help out whenever you need specialized packing information. For information on new packings and gaskets—for engineering and design advice—for tips on more efficient, more economical packing techniques—your Johns-Manville representative is a good man to know.

For information on any Johns-Manville Packings and Gaskets, write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

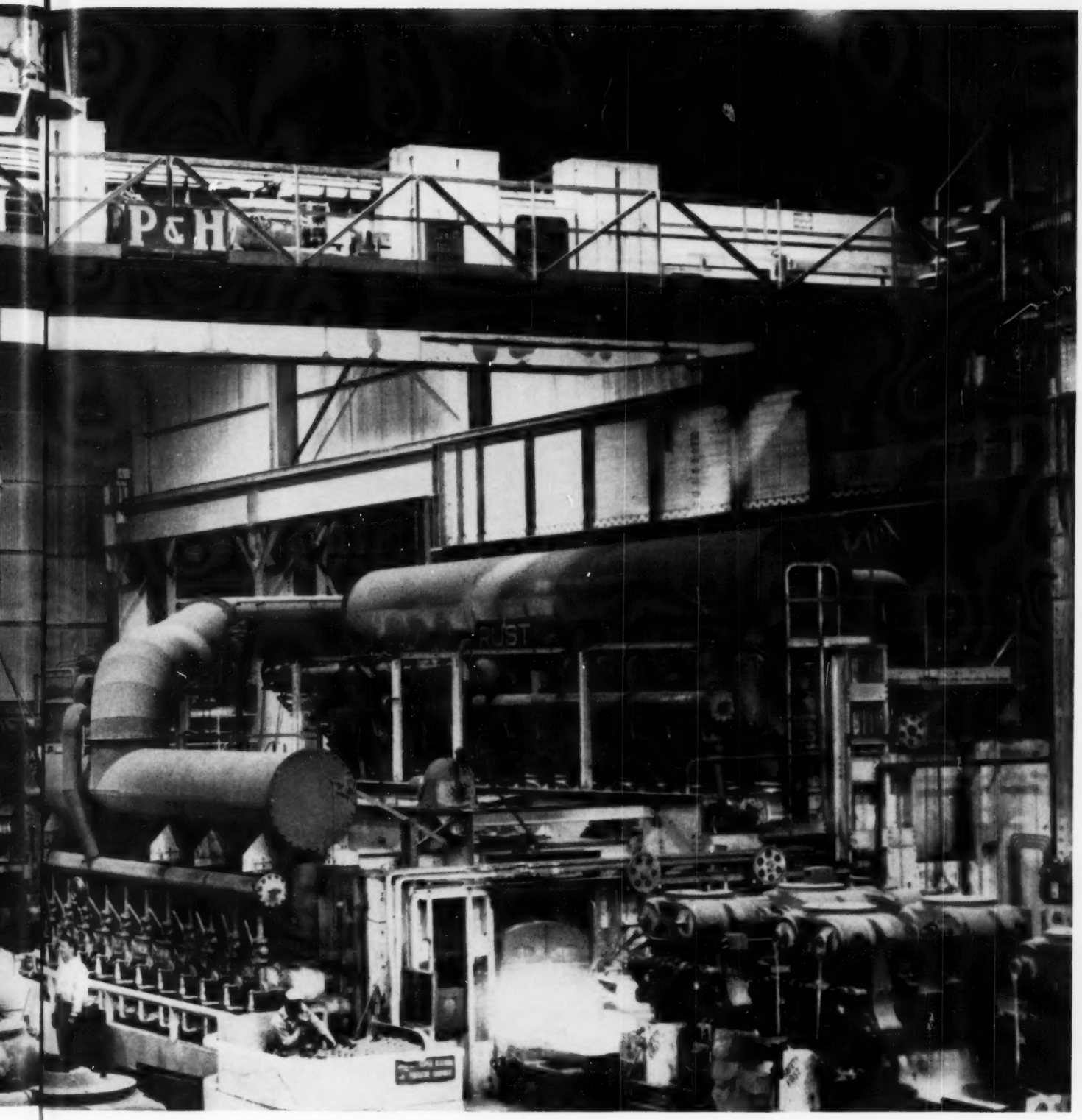
JOHNS-MANVILLE

Speed steel production with faster duty cycles!

It's easier to keep production moving with P&H overhead cranes. They have the power and smooth control that enable operators to spot giant loads quickly and safely. Their electrical and structural parts exceed mill standards — withstand the extremely severe duty cycles found in mill service.

You can rely on P&H research for new developments to increase crane efficiency. The latest, P&H Electronic "Stepless" Control, makes fixed-speed steps obsolete — provides an AC crane with better speed selection than DC control.

The new control furnishes the right speed for



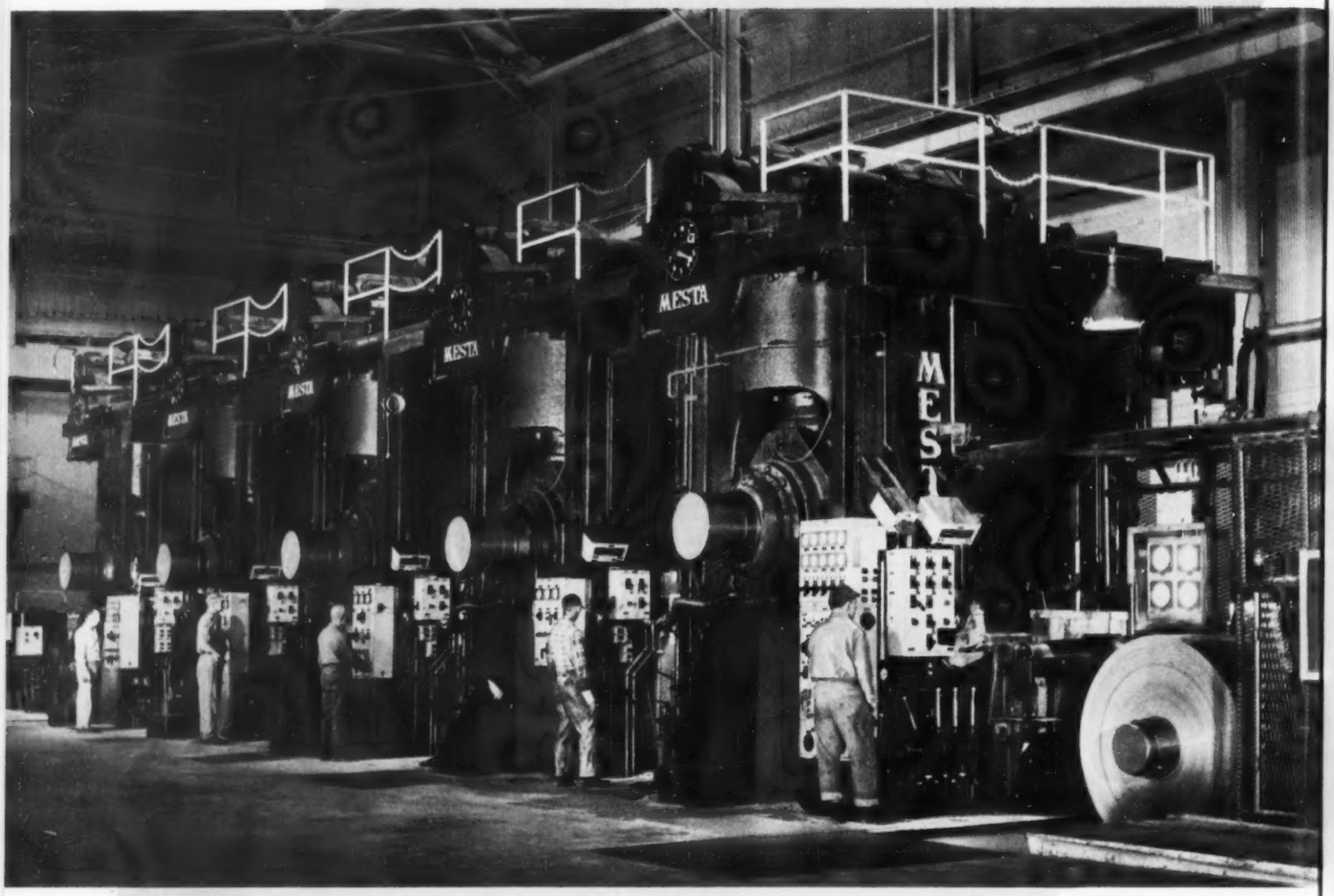
each crane operation — eliminates load sway and jerky "inching." "Stepless" control permits faster, smoother handling and precision spotting of materials for quicker servicing of heavy equipment or movement of material. It has a simple wiring circuit that eliminates 58 contacts, thus slashing crane maintenance and parts inventory.

Find out how you can speed duty cycles and lower costs with P&H overhead cranes. Write Dept. 105G, Harnischfeger Corp., Milwaukee 46, Wis.

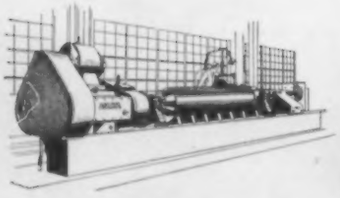
HARNISCHFEGER

P&H ... quality and service for 74 years

MESTA Cold Mills



MESTA 48" Four-High, Five-Stand Tandem Cold Mill
Rolling Strip Steel for Tin Plate in Coils



Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Personnel News...

J. L. Young was named vice president—appropriations, United States Steel Corp.; **J. D. Rollins** was named vice president—facilities planning; and **E. L. Tindall,** vice president—design and construction.

Mr. Young began his business career as sales engineer for the Young Car Co., later joining the industrial bearings division of Timken Roller Bearing Co. as a draftsman. He advanced to assistant general manager of Timken, and in 1936 joined United Engineering and Foundry Co. as manager of machinery sales. During World War II, he served as project manager for the construction of an aluminum rolling mill at Spokane, Wash., for United, then returned to Pittsburgh as vice president in charge of United's industrial research. Mr. Young joined U. S. Steel in 1945 as vice president in charge of engineering and construction for the National Tube Div. He was appointed vice president-chief engineer of U. S. Steel in 1952 and became vice president—engineering a year later.

Mr. Rollins joined U. S. Steel in 1934, and in 1937 was transferred to the Gary Steel Works, where he attained the position of works chief engineer. He returned to Pittsburgh in 1948 as planning engineer, and two years later was appointed assistant chief engineer for the former Carnegie-Illinois Steel Corp. He became assistant chief engineer—manufacturing of U. S. Steel the following year, and in 1952 was made assistant vice president—engineering. He was appointed vice president—engineering for American Bridge in 1955.

Mr. Tindall joined U. S. Steel in 1935 as combustion engineer at South Works of Carnegie-Illinois Steel Corp. in Chicago. In 1939, he was named superintendent of fuel and combustion at South Works, and two years later was transferred to the company's engineering division in Pittsburgh as power, fuel and steam engineer. Mr. Tindall was appointed chief engineer of the Edgar Thomson Works in 1947, and the following year was named Pittsburgh district engineer of Carnegie-Illinois. He became chief engineer—steel in 1953, and was appointed assistant vice president—engineering for U. S. Steel in 1955.

J. L. YOUNG

J. D. ROLLINS

E. L. TINDALL

E. H. GOTT

OSCAR PEARSON

E. B. SPEER

E. H. Gott has been appointed vice president—production-steel producing divisions, U. S. Steel Corp., succeeding **Walter F. Munford,** now executive vice president—engineering and research. **Oscar Pearson** has been made vice president—operations-steel, succeeding Mr. Gott, and **J. F. Core** becomes vice president—operations-coal, succeeding **J. C. Gray** who was made administrative vice president—raw materials. **E. B. Speer,** formerly general superintendent of the Fairless Works, was named general manager of operations—steel, succeeding Mr. Pearson.

Mr. Gott joined U. S. Steel as an industrial engineer at Ohio Works in 1937, after several years of employment in the operating department of the Koppers-Philadelphia Coke Co. He was transferred to Clairton Works of U. S. Steel in 1939 and to Gary Steel Works in 1941. Successively he served as plant industrial engineer, assistant division superintendent—rolling, assistant division superintendent—maintenance, and assistant general superintendent—services. In 1949 he was made assistant general superintendent of South Works in Chicago. In 1951, Mr. Gott was appointed general superintendent of the Youngstown District operations of U. S. Steel, and in 1953 he was made general manager, operations-steel, United States Steel Corp. He was promoted to vice president—operations-steel in 1956.

Mr. Pearson joined U. S. Steel in 1928 as a chemist for the Tennessee Coal & Iron Div. Transferring to Gary Works in 1941 as assistant to the chief metallurgist, he

F. A. DUDDERAR

E. N. HIBBERT

R. F. ARMITAGE

C. H. JOHNSON

was later advanced to chief metallurgist. He was appointed division superintendent of steel production at Gary in 1950 and in 1952 was named assistant general superintendent at U. S. Steel's Duquesne Works. He was made assistant general superintendent of Youngstown District Works in 1953 and general superintendent of South Works, Chicago, in 1954. In June, 1956, he was named general manager of operations—steel.

Mr. Core, before coming to U. S. Steel, worked for four leading coal companies and is well known in the coal mining field. Starting in 1935 with Hillman Coal and Coke, he worked first as a miner. In 1938 he joined Pittsburgh Consolidation Coal Co., being employed in various capacities until 1947, when he became chief engineer at Nemacolin Mine for the Buckeye Coal Co. He then served in the same capacity for Island Creek Coal Co., from 1950 to 1951, when he came to U. S. Steel's Frick District as mining engineer. He was made chief engineer for the district in 1954 and general superintendent in 1955.

Mr. Speer first became affiliated with U. S. Steel in 1938 as a metallurgical observer at the Youngstown District Works. He was promoted successively to superintendent of the Bessemer and open hearth departments and was transferred to U. S. Steel's Gary Works as assistant division superintendent of steel production in 1951. He was appointed division superintendent of steel production in 1952 and a year later came to the Duquesne Works as assistant general superintendent. He was made assistant general superintendent of the Fairless Works in 1955 and became general superintendent of that plant in 1956.

Frederick A. Dudderar has been appointed general superintendent of United States Steel Corp.'s Clairton Works succeeding **David P. Finney,** who is retiring after 50 years with U. S. Steel. Mr. Dudderar has been assistant general superintendent of Clairton Works for the past three years. He joined U. S. Steel at the Clairton plant in 1940. He served in an industrial engineering capacity at Clairton, Pittsburgh and Homestead until 1944, when he was appointed assistant to the division superintendent, coke and coal chemicals division at Clairton. In 1951, he was appointed division superintendent at Clairton, and four years later became assistant general superintendent.

Mr. Finney joined U. S. Steel in 1908 in the open hearth dept. of the Clairton Works. In 1918 he became a turn foreman in the coke and coal chemicals division. Following a series of promotions, he became assistant division superintendent of coke and coal chemicals in 1937, and two years later was appointed division superintendent. He advanced to assistant general superintendent of Clairton Works in 1944, and became general superintendent in 1955.

Edward N. Hibbert succeeds Mr. Dudderar as assistant general superintendent of Clairton Works. He was formerly division superintendent of slabbing and plate mills at U. S. Steel's Homestead District Works. Mr. Hibbert joined U. S. Steel in 1934 as an observer at the Youngstown District Works. He advanced through various metallurgical posts, becoming chief metallurgist in 1951. He was named assistant superintendent of the Youngstown secondary rolling mills in 1954, and a year later was appointed superintendent. He left Youngstown in 1956, to become division superintendent—rolling at the Clairton Works, and moved to Homestead as division superintendent last September.

Richard F. Armitage has been appointed to the newly created position of general superintendent of Republic Steel Corp.'s Warren district. A 25-year veteran with Republic, Mr. Armitage joined the company as a lubrication engineer in Chicago in 1933. He also served there as combustion engineer and general millwright foreman. He moved to Warren as assistant mechanical superintendent in 1946 and became superintendent two years later. In 1956 he became superintendent of construction.

Charles H. Johnson has been appointed superintendent of the Cleveland plant of the Steel and Tubes Div. of Republic Steel Corp. He succeeds **Frank A. Royce** who has been appointed division welding engineer. Mr. Johnson had been superintendent of the Elyria plant of Steel and Tubes. **Byron T. Morris,** formerly assistant superintendent at Elyria, succeeded him in that post with **Don F. Pankoff** being named assistant superintendent. Mr. Johnson came to Elyria in 1956 from the Brooklyn, N. Y., Steel and Tubes plant where he had been assistant plant superintendent. He joined Republic as production manager of the Brooklyn plant in 1940. He was assistant manager of orders at the Cleveland office of the division from 1943 to 1946, but returned to Brooklyn as assistant superintendent in the latter year.

Mr. Royce has spent his entire career with Republic in Cleveland. He joined the Steel and Tubes Div.

Steel plant reports on use of B&W Kaocrete-32 in critical sections of electric furnace roofs:

·36% saving in installation time

·42% increase in roof life

·20% reduction in refractory costs

For further information on how you can profit with B&W Kaocrete-32 in electric furnace roofs, consult your B&W refractories representative or send for technical bulletin RR-46.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide • B&W Ramming Mixes • B&W Kaowool

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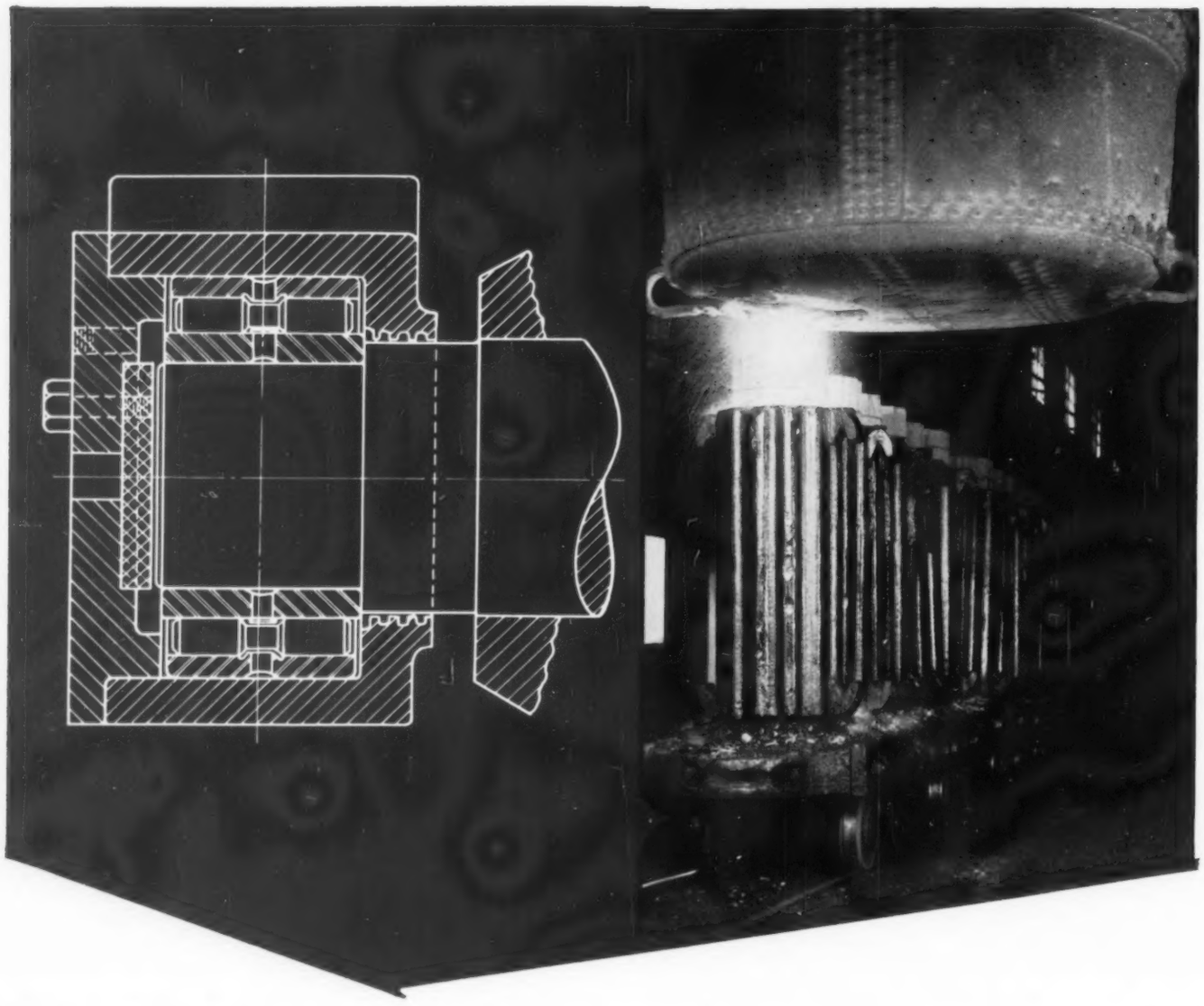

Bearings, Inc. engineering service . . . solves another bearing problem

Ingot mold cars for a large tube mill were continually out of service due to the short life of babbitt, bronze or other bearings originally supplied in the cars.

The Trouble? Bearings, Inc. engineers found shock loads far beyond the capacities of the original bearings. Extreme wear on bearings due to excessive skewing, bent axles and uneven track.

The Answer. Shown above is the Bearings, Inc. drawing of the installation that replaced the original bearings. It has greatly increased load capacity and no dimensional change is required in the shaft or bearing housing.

The Result. The new bearing is designed on a new principle that keeps rollers in line and eliminates skewing. Shock loads due to uneven tracks have little effect on our installation for its construction makes possible a greater number of rollers available to support the load at all times.

This is just one of the many such problems we have solved for our customers. In all cases we supply only bearings we are authorized to distribute. They are new and come to you fresh in the manufacturers' boxes.

If you have a bearing problem or need replacement bearings in a hurry — call or write our branch nearest you, they're ready to give fast service.

Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden
NEW YORK: Buffalo, Balanrol Corp. • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and

in the South ➤ **DIXIE BEARINGS** *INCORPORATED*

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans
N. CAROLINA: Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville

there in 1929, was named welding foreman in 1948 and assistant plant superintendent in 1950.

Mr. Morris has spent his entire business career with Republic's Steel and Tubes Div. at Elyria. He joined the company as an accounting clerk in 1929. In 1940, he advanced to shipping foreman and two years later was promoted to assistant superintendent.

Mr. Pankoff joined Republic as a plant industrial engineer at the Elyria plant in 1940. From 1944 to 1948, he held a similar position at the Cleveland plant. He returned to Elyria in 1948 as general foreman, the position he held at the time of his current promotion.

S. P. Curtis has been appointed chief engineer, Central Operations—steel and coal, of United States Steel Corp. Mr. Curtis formerly was chief engineer of U. S. Steel's Fairless Works. He joined U. S. Steel in 1941 as an expediter in the engineering department at the Gary Steel Works.

Myron E. Strate was appointed division superintendent—maintenance and utilities for Geneva Works, Columbia-Geneva Steel Div., U. S. Steel Corp. In this post, he will direct the activities of Geneva's largest department. Mr. Strate began some 28 years of service with U. S. Steel in 1930, when he was employed as a mechanics helper at the Columbia Coal Mine. Since then, he has held various management posts at Columbia Coal Mine, Youngstown District of Carnegie-Illinois Steel and the Geneva and Ironton Plants. In 1946, he was appointed an electrical engineer in the engineering department at Geneva and, three years later, was named assistant works engineer. He was appointed assistant division superintendent—maintenance and utilities in 1955, the post he held prior to this latest promotion.

James M. Knox was appointed executive vice president and treasurer, and **Dr. H. J. White** was named secretary of Research-Cottrell, Inc. Mr. Knox was formerly assistant director and business manager of the Brookhaven National Laboratory. Dr. White continues to serve as director of research and development at Research-Cottrell in addition to his duties as secretary.

J. M. Cook was named vice president in charge of marketing, and **P. S. Jones** as senior vice president, Cutler-Hammer, Inc. Mr. Jones, formerly vice president in charge of sales, plans to retire at the end of the year after 43 years of service with the electrical firm. Mr. Cook joined the Cutler-Hammer sales dept. in 1928. The following year he was assigned to the company's Milwaukee district sales office. In 1933 he transferred to the firm's Cincinnati district sales office and remained there until 1944 when he was appointed San Francisco district sales manager. In 1952 he was named sales manager, industrial control divisions—a position he held until his new appointment. In his new position he will assume direction of all sales functions for the firm.

Edward J. Udick has been named manager of the Sheet Mill dept. of the Weirton Steel Co., division of National Steel Corp. Mr. Udick succeeds **T. P. "Phil" Caine** who is retiring after a career of 35 years with the company. **Harold E. McDougle** was named assistant manager, being advanced to that position from assistant superintendent of the galvanizing dept. of the Sheet Mill.

Mr. Udick has been in the employ of Weirton for 31 years with all of his service in the Sheet Mill dept. He started in 1927, as a hook-up man in the Sheet Mill bar yard. In 1929 he was named foreman and in 1933 transferred to the Sheet Mill office as order clerk. He was advanced to assistant manager of the plant in 1939, and has served in that capacity continuously until his present promotion.

Mr. Caine came to Weirton in 1923, as Hot Mill foreman in the Sheet Mill when the plant first went into operation. The next year he was transferred to the Sheet Mill office as order clerk. Five years later in 1929 he was promoted to assistant manager and in 1930, he was named manager of the plant.

Mr. McDougle was employed in the Quality Control dept. of Weirton in 1937, and was assigned to the Sheet Mill as metallurgist. In 1949 he was named assistant superintendent of galvanizing.

Robert C. Lubberger was named assistant to the managing director of Armco-Thyssen, a joint company recently formed in West Germany by Armco International and August Thyssen-Huette, a major German steel company. Mr. Lubberger joined Armco in 1941. In 1946, he was assigned to Armco International. Since that time he has held a variety of positions in the company's headquarters, and has been in sales work since 1952.

J. Edward Goodin was promoted from practice man to assistant superintendent of the open hearth department, Granite City Steel Co., and **Merle C. Niepert** was promoted from general melter foreman to general foreman of the department. Mr. Goodin started with Gran-

S. P. CURTIS

M. E. STRATE

J. M. KNOX

J. M. COOK

A. S. MARVIN

F. K. GOODELL

W. L. STOVER

K. H. MEYER

ite City in 1953 as a utilities department foreman. He transferred to the open hearth as a practice man in 1957. Mr. Niepert has been with the company since 1933, when he started in the tin house. He transferred to the open hearth department the following year and was promoted to melter foreman in 1947. He became general melter foreman in 1953.

Arthur S. Marvin has been appointed vice president—engineering of U. S. Steel's American Bridge Div. Mr. Marvin succeeds **J. D. Rollins** who has been named vice president—facility planning, United States Steel Corp. At the same time, appointments were announced of **F. K. Goodell** as chief engineer for the division, **K. D. Cunningham** as district engineer, and **O. H. Ormsby** as assistant district engineer.

Mr. Marvin began with American Bridge as a draftsman at its Gary, Ind., plant in 1924. In 1940 he was made a designer in the division's Chicago engineering department, and seven years later became assistant division engineer at the Pittsburgh engineering offices. One year later he was named division engineer, and in 1955, he became assistant chief engineer. In 1957, he was appointed chief engineer, the position he held at the time of his latest promotion.

Mr. Goodell was first employed by American Bridge in 1937 as a draftsman at the Ambridge plant and was transferred to the Gary, Ind., plant's drafting department the same year. In 1939 he was appointed junior designer—estimator in the division's Chicago engineering office. Following additional service at Gary from 1940 to 1942, he returned to the Chicago offices where he later became an engineer. In 1955, he was appointed district engineer, Pittsburgh engineering office, the position he held prior to his new appointment.

Mr. Cunningham began his U. S. Steel service with American Bridge Div. in 1939 as a draftsman at its Ambridge plant. He advanced successively to junior designer-estimator, senior designer-estimator, and engineer. Since 1955, he had been assistant division engineer.

Mr. Ormsby began with American Bridge as a draftsman at Ambridge in 1937 and was transferred to the Gary, Ind., plant that same year. In 1946 he was advanced to designer-estimator at the Chicago engineering office and became an engineer in 1956.

William L. Stover has been appointed assistant chief engineer of Mesta Machine Co. Mr. Stover has been associated with Mesta for 18 years starting his career in 1940 as an engineering trainee. In 1948 he was promoted to assistant division engineer and in 1953 he became division engineer over one of the departments covering rolling mill design.

Kenneth H. Meyer was elected vice president of C. B. Hunt & Son, Inc. He joined C. B. Hunt in 1954 as assistant chief engineer, and became director of engineering in 1957.

Gerald A. Tamblyn, veteran of 18 years experience in the field of bulk materials handling, has been named sales manager of the new industrial tractor shovel line being introduced by Yale Materials Handling Div., The Yale & Towne Manufacturing Co.

Frank G. Helander has joined Loewy-Hydropress Div. of Baldwin-Lima-Hamilton Corp. Formerly manager of the Hydraulic Press Div. of Birdsboro Steel Foundry and Machine Co., and previously executive vice president of the Watson-Stillman Co., he has been engaged in engineering, sales and administrative work in the hydraulic press and heavy industry field for over 25 years.

Neil J. Culp and **Samuel M. Purdy,** have been promoted by the Carpenter Steel Co. to supervisory posts in the metallurgy department. In his new position as supervisory metallurgist—alloy development, Mr. Culp is responsible for research and development on tool and alloy, high temperature alloy, stainless and magnetic alloy steels. Previously he was in charge of research and development for the tool and alloy steel group only. Mr. Purdy, named supervisory metallurgist—metallography, now takes the responsibility for all metallographic and crystallographic activities of the Carpenter research laboratory. Formerly he was a group leader in charge of stainless steel research and development.

Robert H. Gage has joined the planning and development dept. of the Rust Engineering Co. Before joining the Rust organization, Mr. Gage was assistant central district manager of the H. K. Ferguson Co. Previously he was associated with Arthur G. McKee, and J. F. Pritchard & Co.

C. Glen Bigelow, Jr., was appointed to the newly-created position of director of research, Selas Corp. of America. He comes to Selas from American Machine and Foundry Co., where since 1951 he has served as technical director of the General Engineering Labora-

1500-ton hydraulic free-forging press in operation at one of the leading mills for specialty steels. Manipulator is at left, high-pressure water station at rear, scale remover chute at bottom.

Because the new specialty alloy steels must be metallurgically perfect . . . Loewy forging presses

New alloys are coming into existence continually. Each is developed for unusual requirements—each has a different application.

Advances in the missiles field and in nucleonics demand the newest methods to produce these high-quality alloys. Specific service conditions, such as temperature range, stresses, corrosion by gases and nuclear liquids, all call for special properties—sometimes for unusual combinations of them.

Loewy forging presses assure metallurgical perfection of the product. It is generally agreed in the trade that—as one of our customers put it—our presses "*impart to special steels internal qualities never before achieved.*"

Loewy forging presses are designed for full accessibility of tooling, for easy supervision and maintenance. Fast closing, working and return speeds cut down idle time and prevent heat loss in the workpiece. Strokes per minute for planishing are unsurpassed by any other type of forging equipment. Pressure, tonnage and speed can be varied within a wide range to suit special requirements.

On Loewy presses, the machine parts exposed to the heat of the workpiece are protected and allow for thermal expansion. Heaviest eccentric loading is provided for. Any likelihood of fatigue failure is removed by careful design analysis. Loewy hydraulic forging presses have repeatedly proved that they outproduce hammers in working specialty alloy steels.

Loewy designs and builds open and closed die forging presses ranging from the much publicized 50,000-ton-capacity giant at Wyman-Gordon to a 660-ton midget in the same shop.

For information on how Loewy forging presses can solve your production problems, write us today, Dept. C-4.

Loewy-Hydropress Division

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Get the *right* answers to your Roll problems from "YOUNGSTOWN"

hot and cold strip mill maintenance specialists

Q. How can scratching, galling, pickup, and excess wear be eliminated?

A. Use PARALLOY... the Rolls of uniform hardness all through. Roll more tonnage from new to scrap diameter.

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HOT STRIP COILER ROLLS • COILER PINCH ROLLS
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Q. How can heat check, warpage and cracking be overcome?

A. Let Youngstown's proven experience with Ductile Cast Iron help you in the applications at right.

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Ductile Cast Iron Rolls are reducing maintenance in hot strip mills . . . especially good under the sprays. We invite your inquiries on rolls or any other ductile iron castings up to 50,000 pounds.

The Youngstown Foundry & Machine Co.

Youngstown, Ohio

E. H. KOONTZ (left)
H. A. LATTA (center)
E. R. HUCKMAN (right)

tories in Greenwich, Conn., and more recently as new products secretary in the firm's New York City headquarters. He was also previously associated with Loftus Engineering Co., as assistant chief engineer and with U. S. Gypsum Co. as research engineer at the building materials research laboratories located in Chicago.

Elwood H. Koontz, the Reliance Electric & Engineering Co. district manager in Pittsburgh for the past four years has moved to Chicago, and will succeed **R. O. Herbig** as central west regional sales manager upon Mr. Herbig's retirement in the spring, after 40 years with Reliance. **Andrew C. Perrin** has been advanced from district sales manager of the San Francisco-Pacific Northwest district to western regional sales manager, and will continue his headquarters at the company's distribution center in Burlingame, Calif. Mr. Koontz joined Reliance in 1936, and has held sales engineering, branch and district management assignments with Reliance in Philadelphia, Minneapolis, New York, Newark and Pittsburgh. He has been succeeded in Pittsburgh as district manager, by **Howard A. Latta,** Reliance's manager in Los Angeles since 1945. **Walter A. Jensen** has been appointed to fill the vacancy of district manager in Los Angeles.

E. R. Huckman has been appointed assistant field sales manager of The Foxboro Co. Although Mr. Huckman will continue as regional manager of the N. Y. area, including sections of Conn., N. J., and N. Y., his duties as manager of the New York city branch have been assumed by **H. R. Cushman,** formerly sales engineer at New York.

T. S. Pacer was elected executive vice president, Illinois Gear & Machine Co. Mr. Pacer was formerly vice president of the company and in its employ for 25 years.

W. J. Brown has been appointed staff product application engineer in the Marketing Technical Service Div. of the Gulf Research & Development Co., research subsidiary of the Gulf Oil Corp. In his new position, Mr. Brown will be handling all steel plant technical service activities. Mr. Brown was formerly the lubrication engineer of American Steel and Wire Div., U. S. Steel Corp.

Philip A. Gaebe has been promoted to assistant eastern regional sales manager of the Kaiser Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc. Since 1956, Mr. Gaebe has served as district sales manager, covering a large portion of the eastern region. Prior to joining Kaiser Chemicals as a senior sales engineer in 1952, he served with U. S. Steel Corp. at Gary, Ind., and with Kaiser Steel Corp. at Fontana, Calif.

N. F. Moody has been appointed district manager, Philadelphia, and **H. F. Colt, Jr.,** has been appointed district manager, Boston, Air Reduction Sales Co. Mr. Moody, formerly Boston district manager, replaces **E. B. Walker** who is retiring after almost 34 years of service. Mr. Colt, formerly assistant district manager, Philadelphia, replaces Mr. Moody in Boston.

A. P. Bowman has been named manager of Allis-Chalmers Manufacturing Co.'s Milwaukee district office, and **James I. Onarheim** was named to the new post of manager of utility sales, Milwaukee district. Mr. Bowman was manager of the company's Rockford, Ill., branch office since 1956. Mr. Onarheim was a sales representative in Milwaukee since 1948.

Dr. J. Daniel Bode has been promoted to research supervisor in Jones & Laughlin Steel Corp.'s Research and Development dept. Dr. Bode, formerly a research engineer, joined J&L in 1955.

David A. Mallett has been named application engineer, Furnace and Kiln Div., Selas Corp. of America. Mr. Mallett has previously been associated with W. S. Rockwell Co., and R-S Furnace Co.

Joseph D. Brick has been appointed east central regional manager, Square D Co., and **Charles W. Duffett** has been named Pittsburgh district manager. Both positions are the result of setting up a new region to include the territories of Pittsburgh, and Buffalo and Rochester, N. Y. Mr. Brick has previously been manager of the

J. D. BRICK
C. W. DUFFETT

Pittsburgh office, and has been associated with the company for the past 31 years. Mr. Duffett has previously been a field engineer in the Pittsburgh office.

R. S. Poister, senior vice president of Crucible Steel Co. of America has retired. Mr. Poister, a 44-year veteran of the steel industry, joined Crucible in 1947 as vice president—operations, Pittsburgh district. He was named vice president—operations for the entire company in 1949, and has been senior vice president since 1954. He began his career in steel in 1914 with Cleveland Furnace Co. His last position before joining Crucible was that of manager—Chicago district for Youngstown Sheet and Tube Co.

R. A. McNeilly was appointed works manager for Tube Reducing Corp. Mr. McNeilly was previously manager of fabricating engineering for the Metals Div. of Olin-Mathieson Chemical Corp.

Robert B. Zane has been appointed to the newly established office of manager, utilities and industrials, at the Chicago office of The Okonite Co. **Clifford B. Sass, Jr.,** will handle Mr. Zane's previous post as manager, railroad sales, in the Chicago district.

Paul R. Brucker was named to the newly created position of plant metallurgist, Midland Works, Crucible Steel Co. of America. At the same time, **Claude M. Sheridan** has been named division metallurgist—flat rolled products, the position formerly held by Mr. Brucker.

H. R. Edelman, Jr., president, Heyl & Patterson, Inc., was named chairman of the board. Other changes were: **E. W. Kahle,** executive vice president and general manager; **J. F. Page,** vice president and treasurer; **H. R. Edelman, III,** secretary. **H. R. Edelman, III,** was elected to the board of directors and **J. F. Page** to the executive committee to fill the vacancies caused by the death of **T. P. Butler,** former chairman of the board.

William McNeil has been appointed New York district sales manager for the Jones Machinery Div. of Hewitt-Robins, Inc. Mr. McNeil will be responsible for the sale of Jones power transmission equipment in the Philadelphia and New York area.

Ward F. Simmons has been appointed chief of the High-Temperature Metals Research Div. at Battelle Memorial Institute. In his new position, he takes charge of research in this specialized area of metallurgy with which he has been closely associated at Battelle for the past 17 years. His studies have ranged from one on manufacturing variables affecting high-temperature properties of steels to one for evaluating super-alloys used in jet aircraft engines. He has also aided in the development of equipment and techniques for vacuum-creep studies.

Elbridge H. McNeill has been named regional sales manager of the newly-formed Mid-West sales region of The Okonite Co. A member of the Okonite sales force since 1925, Mr. McNeill has served as Chicago district manager for the past five years.

Carl W. Pinkham has been appointed manager-instrument transformer engineering at General Electric Co.'s Instrument Department, West Lynn, Mass. Formerly manager of the department's utility systems engineering, he succeeds **Joseph D. Thompson** who has been named manager-aircraft instrument engineering.

John T. Patterson has been appointed service supervisor for Allis-Chalmers Manufacturing Co.'s West Allis Works. He succeeds **R. R. Goetz** recently appointed service manager—Midwest region.

CHAIN BUYERS & USERS—Now you can be sure of the make of chain you are getting and of the grade (strength) of the chain you are using...a definite safety advantage. Presently available on Inswell Proof Coil, BBB, High Test and Herc-Alloy chain in all sizes under ½".

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COLUMBUS McKINNON CHAIN CORPORATION
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Obituaries

Archie S. McGibbon, project facilities engineer for Lukens Steel Co., died March 23. He had been with Lukens for 23 years.

William F. Powell, 59, superintendent of the Electric Melting dept. at Crucible Steel Co. of America's Sanderson-Halcomb Works at Syracuse, N. Y., died February 17. Mr. Powell had been active in electric steelmaking for almost 41 years. He joined Crucible in the Sanderson-Halcomb Works' Electric Melting dept. in 1917. After serving in other capacities, he was appointed assistant superintendent of the department in 1945, and had been superintendent since 1947.

Carloss H. Walter, mechanical engineer for American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio, died March 11.

Joseph H. Dillon, chief engineer of Wisconsin Steel Co., died April 2. He was formerly assistant chief engineer of Edgar Thomson Works, U. S. Steel Corp.

Publication Service...

APRIL, 1958

(1) Wire Rope Storage and Lubrication

A new informative bulletin entitled "Storage and Lubrication of Wire Rope" has been announced by Leschen Wire Rope Div., H. K. Porter Co., Inc. The proper procedures to follow when either new or used wire rope is to be stored are described in detail, as are the various steps to take when the rope is put back into service. The need for proper lubrication is also discussed, together with a number of methods by which lubricants may be conveniently applied.. (Bulletin No. 103)

(2) Control Devices

General Electric Co. has published a catalog covering their complete line of control devices manufactured by their General Purpose Control Dept. Selection charts covering starters through 200 hp provide quick selection of the proper starter, heater and pushbutton station for any type of enclosure. This illustrated catalog has guide form specifications for easy and accurate designation of controls by distributors, contractors or architectural specifiers. The publication includes complete product descriptions of motor starters, contactors, relays, solenoids, limit switches, pushbuttons and pilot devices. It also contains prices, features, wiring diagrams, dimensions and application information for each device. Indexed for easy reference, the detailed booklet includes the new manual and magnetic motor starters, illuminated oiltight and push-to-test pushbuttons, full acceleration part-winding starters. (GEC-1260C)

(3) Electrical Connector Catalog

The Pyle-National Co. announces the availability of a 62-page catalog on their new "Pyle-Star-Line" compact, low-weight, environment-resistant connectors. Two major series of connectors are fully described with detailed specifications and selection data.

Also included are the Series "S" and Series "CS" connectors with delayed action to meet MIL-E-5272, method I requirements for various fuels, in addition to many useful wire tables showing allowable current-carrying capacities, and other excerpts from the NEC codes.

(4) Materials Handling Equipment

A loose-leaf catalog describing their many types of materials handling equipment is available from Heppenstall Co. Entitled "Everything that Hangs from the Crane Hook," the catalog includes automatic and motorized tongs for lifting material of any shape, weight or size, as well as sheet lifters, rack lifters, motorized rotating hooks, "C" hooks and other hooks. The catalog shows nearly 100 items, ranging from tiny automatic tongs that weigh only 1 lb each up to massive equipment that will lift loads of many tons. The basic arrangement is by the shape of the material to be lifted, whether square or rectangular, circular or cylindrical. Special pages are devoted to coil tongs and to tongs that lift and turn an object at the same time. Warehouse applications and conveyor line applications are among those illustrated. Shown for the first time are new motorized tongs for lifting coils vertically, and the Heppenstall line of forged crane hooks. A section of equipment available from stock includes four new types of tongs and two new sheet lifters.

You Can Obtain . . .

. . . any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

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50	ADALET MANUFACTURING CO., THE	BULLETIN 158	Weather-proof and explosion-proof housings
51	AMERICAN AIR FILTER CO., IN3	BULLETIN 248-C	Air filters
52	ASKANIA REGULATOR CO.		Furnace controls
53	ATLAS CAR & MFG. CO.	BULLETIN 1283	Transfer cars
54	AUTOMATIC TRANSPORTATION CO.		Electric transporters
55	BABCOCK & WILCOX CO., THE	BULLETIN RR-46	Refractories
56	BAILEY METER CO.	SPECIFICATION E65-3	Combustibles analyzer
57	BLISS CO., E. W.	BULLETIN 40-B	Rolling mills
58	BUFFALO FORGE CO.	BULLETIN FD-205	Radial blade fan
59	CHEMICAL CONSTRUCTION CORP.	BULLETIN M-103	Venturi scrubber
60	CLEVELAND WORM & GEAR CO.	BULLETIN 145	Worm gear speed reducers
61	CROUSE-HINDS CO.		Control of electrical explosion hazards
62	DELAVAL STEAM TURBINE CO.	BULLETIN 1004	Centrifugal pumps
63	ELECTRIC CONTROLLER & MFG. CO.	BULLETIN 1300-8D	Lifting magnets
64	EUCLID ELECTRIC & MFG. CO., THE	BULLETIN 2016	Push-button stations
65	FARVAL CORP., THE	BULLETIN 26-S	Lubrication
66	GENERAL ELECTRIC CO.	GEA-6434	D-C crane control
67	HILL ACME CO., THE CLEVELAND KNIFE DIV.		Metal shearing aids
68	INDUSTRIAL GEAR MFG. CO.		Gears
69	I-T-E CIRCUIT BREAKER CO., SWITCHGEAR DIV.	BULLETIN 6004	Low voltage switchgear
70	JOHNS-MANVILLE CORP.	IN-115A	Insulating fire brick
71	KOPPERS CO., INC., FREYN DEPT.		Motor operator for snort valve
72	LECTROMELT FURNACE DIV., McGRAW-EDISON CO.	CATALOG NO. 10	Furnace equipment for melting and refining
73	LINK-BELT CO.	BOOK 2447	Motogears and gearmotors
74	MASTER BUILDERS CO., THE		Grouting guide
75	NORTH AMERICAN MANUFACTURING CO., THE	BULLETIN 5854	Car thawing units
76	PANNIER CORP., THE		Marking devices
77	POOLE FOUNDRY & MACHINE CO.		Flexible couplings
78	POST-GLOVER ELECTRIC CO., THE	BULLETIN 500	Steel grid resistors
79	RADIO CORP. OF AMERICA		Industrial television
80	REPUBLIC FLOW METERS CO.		Pneumatic instruments
81	ROCKBESTOS PRODUCTS CORP.	RSS-88	Cable
82	RUST-OLEUM CORP.		Rust preventive coating for galvanized metal
83	SHEFFIELD CORP., THE		Device for measuring thickness accurately without touching the material
84	SYNTRON CO.		Shaft seals
85	TAYLOR SONS CO., CHARLES	BULLETIN NO. 314	Super-refractory cements
86	UNITED STATES GRAPHITE CO., THE	CATALOG B-56	Brushes
87	WALDRON CORP., JOHN	CATALOG 57	Gear couplings
88	WESTERN GEAR CORP.		Gearmotors
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FELLER ENGINEERING CO.

presents

SCHLOEMANN

Steel Extrusion Press

The demand for solid and hollow steel sections and tubes which can be rolled only with difficulty, or not at all, led to tests in the use of the extrusion press, as this had already proved itself successful in the production of non-ferrous metals. Since 1930, SCHLOEMANN tube and rod extrusion presses of conventional design have been used for the extrusion of steel. On the basis of experience gained through extended co-operation with manufacturers and experts in tool steels, tools and extrusion processes (Séjournet), SCHLOEMANN have developed a steel extrusion press of completely novel design.

Technical data

Normal power	1780 tons
Piercing power	220 tons
Total power	2000 tons
Maximum circle circumscribing biggest section	6⅛ inch
Average hourly production	10 tons

Controls

Once it has been initiated from the control desk, the operational sequence necessary for the performance of a single extrusion cycle is automatically controlled. Eight different operational sequences can be set up by means of the programme control.

Features and advantages

Protection of the guide ways. The four-column design allows the guide ways for the moving platen and billet container to be arranged above the press centre-line. Thus, particles of glass and scale cannot settle on the guide ways; these are kept clean by water spray which at the same time acts as a lubricant.

Correct positioning of the billet container. By means of a connecting piece to keep the hydraulic sealing pistons working in exact parallel motion, the billet container is always centered in regard to die and counter platen.

Swivelling arm for die and butt-end with dummy block. At one end, the die is carried by the swivelling arm by means of a quick-action lock. As the die can be moved axially on the arm, the extrusion can be cut by the pendulum saw in front of or behind the die. At the opposite end, the swivelling arm carries a receiver for the butt-end with dummy block. This permits two important operations to be performed simultaneously.

Short dead times. The operational sequence is shortened by specially designed equipment for changing the tool, transporting the billet, dummy block and extrusion, and for cutting the butt-end and cleaning the container.

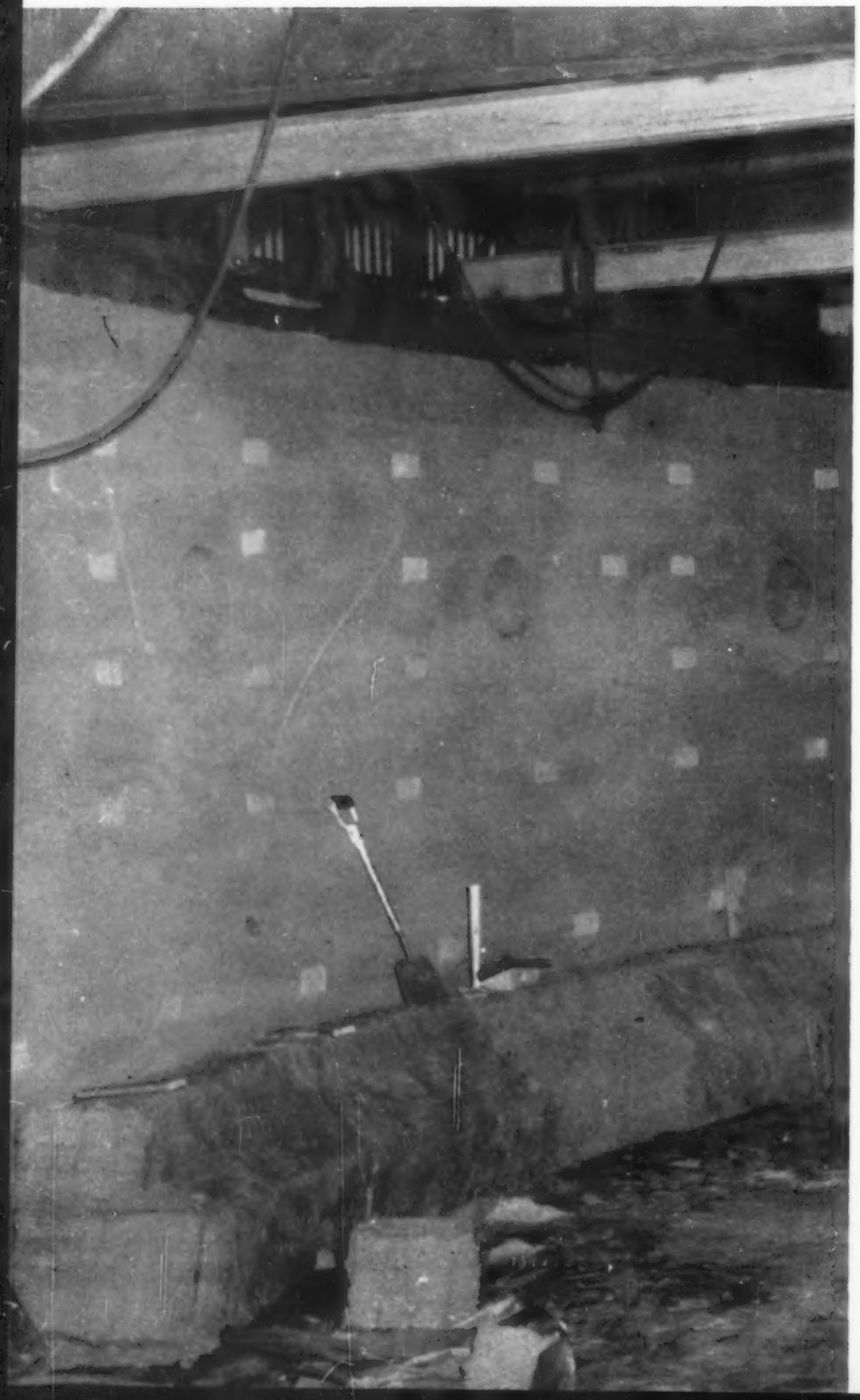
Production of tube rounds and hollow sections. Billets can also be pierced in the press by means of the mandrel. By using previously pierced or drilled billets, an important increase in production figures is obtained.

The first Steel Extrusion Press built in Germany. Supplied by Schloemann in 1957 for a West German Steel Producer.

FELLER ENGINEERING CO., 1161 EMPIRE BUILDING, PITTSBURGH 22, PA.

Ramtite®

Past Performance Got the Order——



The order to line the inner and outer walls, sub-hearth and hearth rim of this 55 ft. rotary hearth furnace was based on past performance—cost reducing Ramtite performance in existing furnaces at this mill. The furnace was designed and built by Salem-Brosius, Inc., and the installation was made in August, 1956.

The walls were lined with Special Super Ramtite No. 25 securely tied back to the steel structure with Ramtite Safe-Tie Refractory Anchors.

Ramtite WASP No. 30 was used in place of rim tiles to line both the inner and outer hearth rims.

A sub-hearth of LWC light weight castable 5″ thick, topped with Fracto-Crete No. 62 refractory castable 5″ thick was installed between the hearth rims.

Ramtite is our business . . . Not

Present Performance Proves It

Now, after more than a year and a half of top service, the Ramtite installation still looks extremely good.

The Ramtite wall construction and inherent spall resistance have prevented any wall bulging or spalling.

The difficulties often encountered with rim tile have been eliminated. Ramtite WASP No. 30 will not spall or work loose, move out and jam into the sides of the furnace.

And, a brick curtain wall installed when the furnace was built, has since been replaced with Ramtite at the customer's request and to his satisfaction.

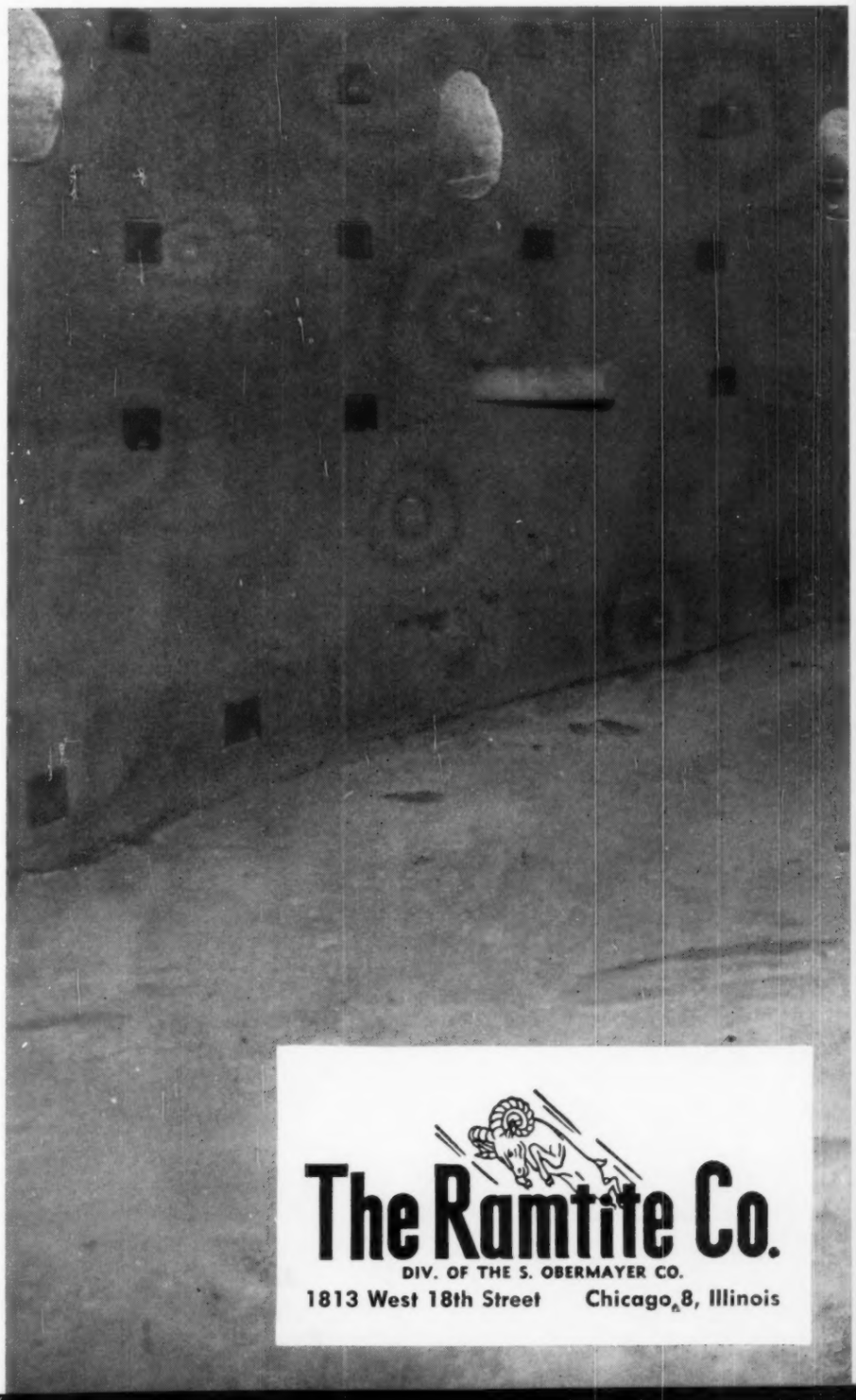
Ramtite past performance got the order!

Ramtite present performance proves it!

The Ramtite Co. offers you a complete sales engineering service. Experienced men are always available to study your refractory problems and consult with your Engineering, Mason and Ceramic Departments about your specific needs.

Write us today for further information.

. . . **Not a side line!**



The Ramtite Co.
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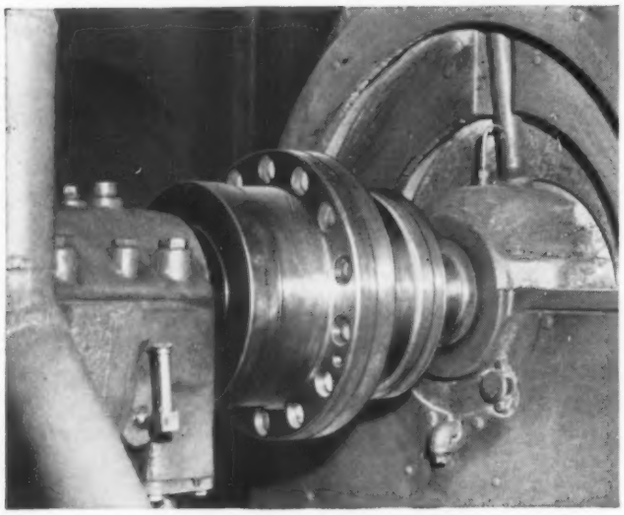
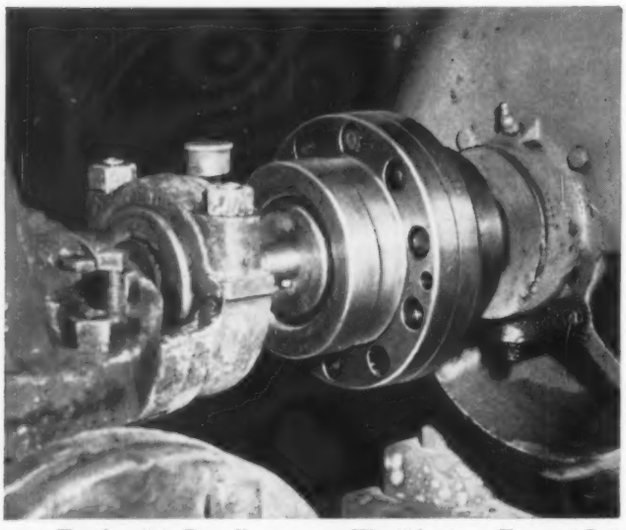
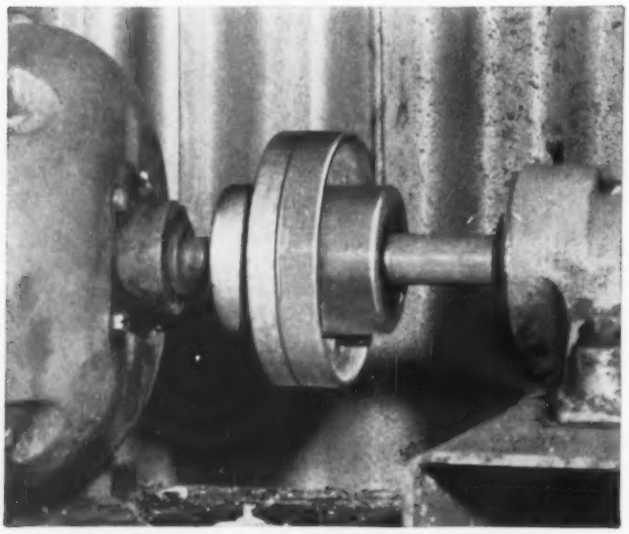


Fast's #4½ Coupling on a 1200 GPM Wilson-Snyder descaling pump. A 1500 hp., 1770 rpm motor drives the unit which operates at a head of 1250′.



Fast's #2 Coupling on a Worthington Type 4-L-1 1000 GPM pump operating at a head of 175′. Pump speed is 3570 rpm. Motor is 60 hp.



Fast's #1 Coupling on a 2500 CFM ventilating fan. Fan motor is 1½ hp. Rpm is 1800.

Detroit Steel Keeps 100 Fast's Couplings at Work with Only Minimum Maintenance

Fast's Couplings have reduced costly downtime and maintenance at Detroit Steel Corporation's Portsmouth, Ohio hot strip mill. Over 100 in number, they range in size from #1 to #20. Many of these couplings have operated with practically no maintenance for six years. Detroit Steel chose Fast's Couplings because of their *sound basic design.*

Here's why Fast's design pays off in low-cost maintenance and trouble-free performance: mechanical flexibility compensates for misalignment. Couplings last longer because there's no metal-to-metal wear. Positive lubrication forms a film on load-carrying surfaces. Metal-to-metal seal keeps out dirt, grit and moisture.

For more details, write to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3004, Scott St., Baltimore 3, Md.

THE ORIGINAL

KOPPERS

FAST'S Couplings

Engineered Products Sold with *Service*

Applications for AISE Membership

Active

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Asst. Supt. 10-in. Mill
Bethlehem Steel Co.
Lebanon Plant
Lebanon, Pa.

HAROLD E. BROWN, JR.
Foreman—Primary Mills
U. S. Steel Corp.
Clairton, Pa.

VERNON J. BROWN
General Foreman—40-in.
Colorado Fuel & Iron Corp.
Pueblo, Colo

CHARLES E. BOWMAN
Mechanical Foreman Coke Plant
Colorado Fuel & Iron Corp.
Pueblo, Colo.

DAN E. BROPHY
Fuel Eng.—Open Hearth
Colorado Fuel & Iron Corp.
Pueblo, Colo.

HARRY E. CAMPBELL
Turn Foreman
Republic Steel Corp.
Warren, Ohio

J. DAVID CARR
Supt.—No. 18-43-in. Hot Strip Mill
U. S. Steel Corp.
McDonald Works
McDonald, Ohio

WILLIS F. DABERKOW
Turn Foreman—40-in. Mill
Colorado Fuel & Iron Corp.
Pueblo Plant
Pueblo, Colo.

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U. S. Steel Corp.
Columbia-Geneva Steel Div.
Torrance Works
Torrance, Calif.

GERALD BARRY DAVIS
Development Engr.
Richard Thomas & Baldwins Ltd.
Bridgend, Glamorgan,
Great Britain

MICHAEL F. DENSHAR
Blooming Mills Supt.
Wisconsin Steel Div.
International Harvester Corp.
Chicago, Ill.

BYRL EBERT
General Foreman Billet Condition Yard
U. S. Steel Corp.
Fairless Works
Fairless Hills, Pa.

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Blast Furnace Practiceman
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Pueblo, Colo.

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Gary Steel Works
Gary, Ind.

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Pueblo Plant
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Hot Rolling Mill Supt.
Th. Wuppermann GMBH
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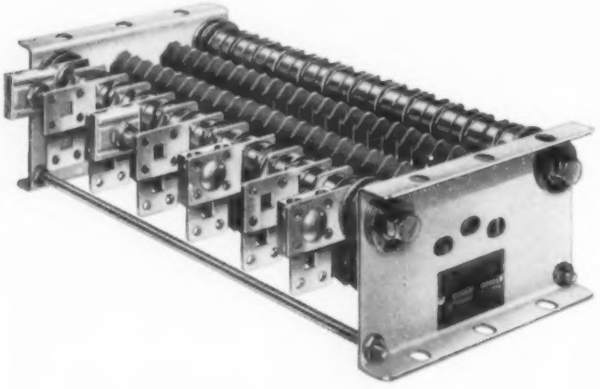

Resistors represent only a small part of a charging machine, but the duties they perform are of the utmost importance to its operation. In this stage of steel making, a charging machine must be able to start, stop, reverse and change speed regularly and continuously during its operating cycle. P-G Steel Grid Resistors have been handling their part of this job with a remarkable service record in many plants. For continuous "Trouble-Free Service" on this and all other steel mill applications, specify P-G the ORIGINAL Steel Grid Resistor.

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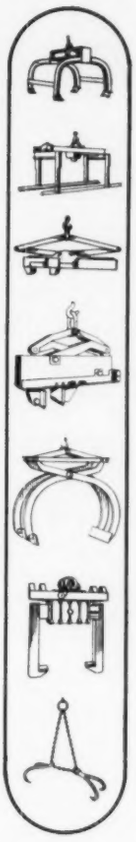
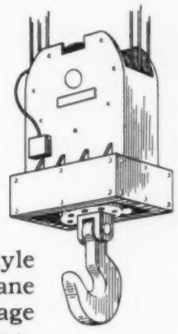
No. 2

Facts About: MANSAVER® GRABS

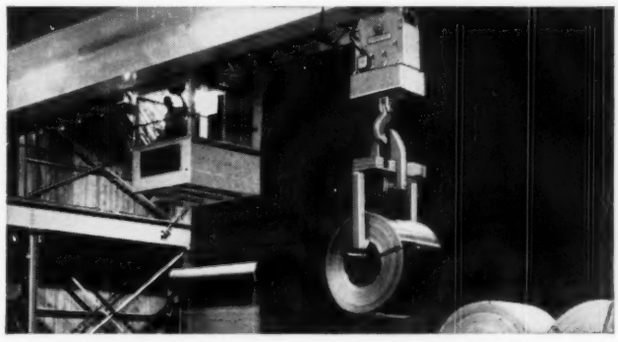


MOTORIZED CRANE HOOK

Increases Storage Area



This Mansaver style 1588 Motorized Crane Hook increases storage area by positioning material more efficiently. This crane hook can be supplied for either hook suspension, or with built-in sheaves, for low headroom and increased stability. A full 360 degree rotation is provided.



For use with motor-driven grabs such as the 1418 pictured, collector rings are supplied for carrying current to the grab. The hook is driven by a totally-enclosed hoist-type motor and a worm-gear reducer. The hook itself is mounted in a yoke, and can be rocked freely in a full 180 degree arc at any position in its 360 degree rotation. Mansaver low headroom motor driven crane hooks are in operation in capacities from 2,000 to 100,000 pounds.

Write for names and addresses of neighboring plants where you can see Mansaver grabs in operation.

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Also Manufactured in England

Where we stand in the fight against CANCER ...and why your dollars are urgently needed now!

DECISIVE PROGRESS has been made in the fight against cancer in the last decade. Today one in every three persons who have cancer is saved. A few years ago it was only one in four.

Still more lives can be saved with what doctors know *now*, if all adults will have a health checkup every year. Many cancers are curable if discovered early and treated promptly.

The major hope for the future conquest of cancer lies in research. About twenty million Americans living today are marked for death from cancer unless research finds new means of curing the disease, or preventing its onset.

What new knowledge has been won to brighten cancer's darkness? High on the list is the discovery of chemicals which cause some cancers to shrink . . . and put victims of this disease back on their feet for a time. There are sound, scientific reasons to believe that more effective chemicals will come which may possibly *cure* one or more forms of cancer.

Equally remarkable are the advances in surgery for cancer . . . permitting wider removal of malignant growths with less risk to patients and far greater chances to control the disease.

The scoreboard of cancer progress also includes methods for treating some cancers with hormones, which prolong the active, useful lives of many patients . . . tests for early diagnosis of some common forms of cancer . . . development of X rays with power undreamed of 10 years ago . . . incredibly delicate techniques by which the living chemistry of a single body cell can be studied.

Immense new research projects are under way and might be expanded to answer such questions as:

> Are the tiny organisms called viruses significant factors in the cause of cancer in man, as they are in some cancers in animals? Why do cancers grow rapidly in some patients, slowly in others? If some people are immune or more immune to cancer than others, how can that immunity be strengthened? What elements in our environment may be causing cancer?

Important findings must be moved from the laboratory table to the hospital bed. The step from test tube to patient is difficult, time-consuming and costly. As research goes forward, and new leads open up, more and more work will be done directly with patients with cancer. Thus, research costs will snowball as science continues to press towards its goal.

Your support of the American Cancer Society's Crusade has already brought significant gains in the control of cancer. More lie ahead . . . will you make them possible? Let your dollars work for you and for your children and for their children.

Send your check today to "Cancer," in care of your local post office.

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Send for this *free* grouting guide which clearly illustrates 11 common machinery settings, methods of grouting and forming, and hot and cold weather grouting. Discussion covers proper mixing and placing of grout, reasons for using prepared, non-shrink grout, etc.

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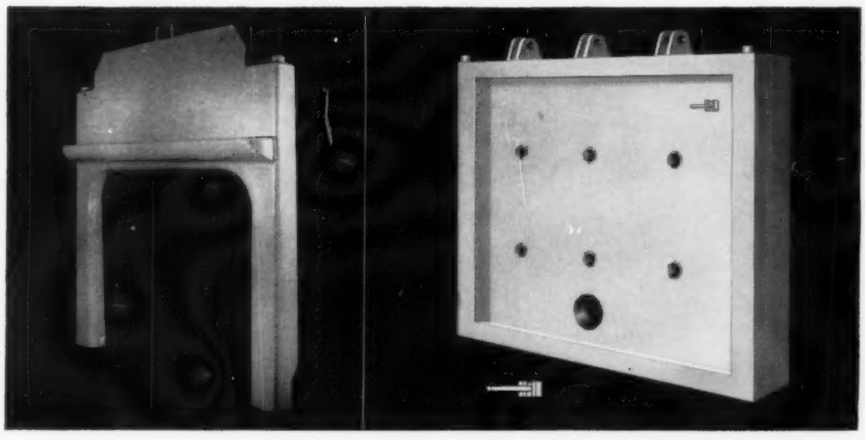

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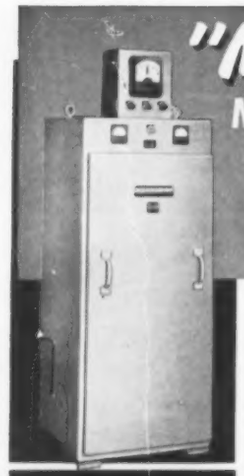

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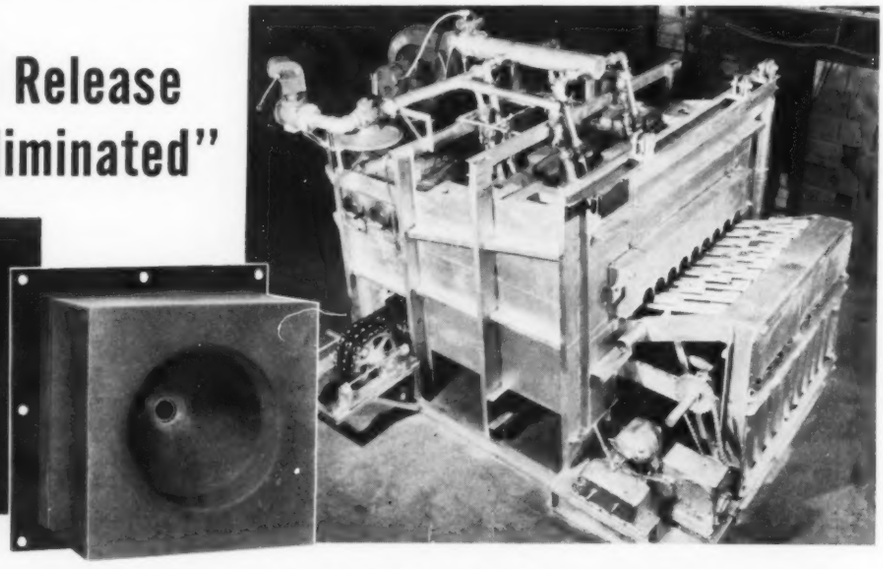

Forge heating output raised 44% above estimate

This pusher type forging furnace, built by J. A. Kozma Company and designed to heat 2500# of steel per hour to 2250°F. with 4 million Btu/hr. input, has actually been heating 3600#/hr. with the same heat input—44% above expected capacity. Heating rate is now equal to 135# per sq. ft. of hearth area.

The furnace is roof-fired by Hauck Series RCG "Hi-Radiant" Cone Gas Burners, without flame impingement on the forgings. High speed combustion, with short flame length and low forward velocity of combustion gases, permit placement of the burner cones closer to the work, with resultant intense heat radiation and uniform heat absorption. Scaling has been practically eliminated. Turndown ratio is 10 to 1.

All this adds up to more output in a smaller furnace with less fuel and less maintenance of burners.

Whether for high speed heating—even to 2900°F.—or low temperature processing. "Hi-Radiant" Cone Gas Burners on your furnaces can spell definite economies in installation and production cost.

Let Data Sheet 809 help you evaluate what these Series RCG Burners can do for your heating operations.

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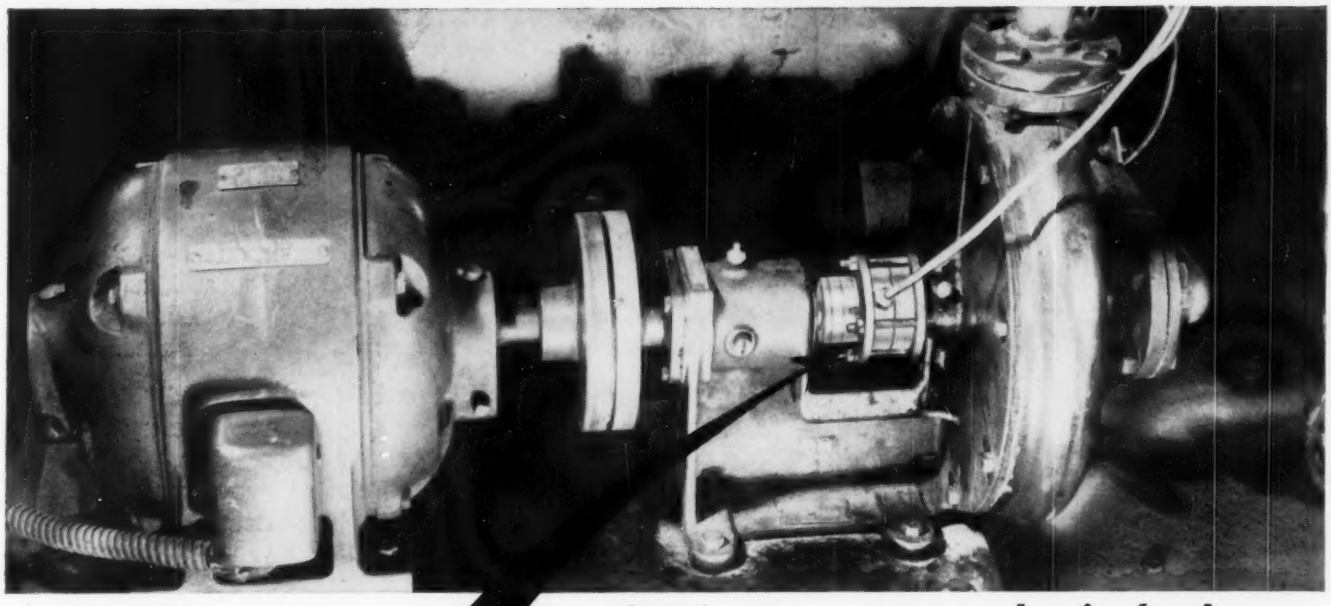
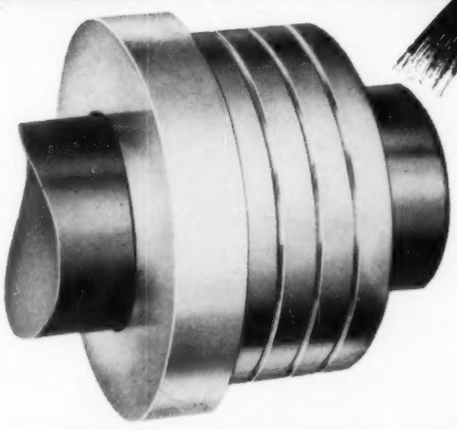
SYNTRON Mechanical SHAFT SEALS





eliminate pump shaft leakage

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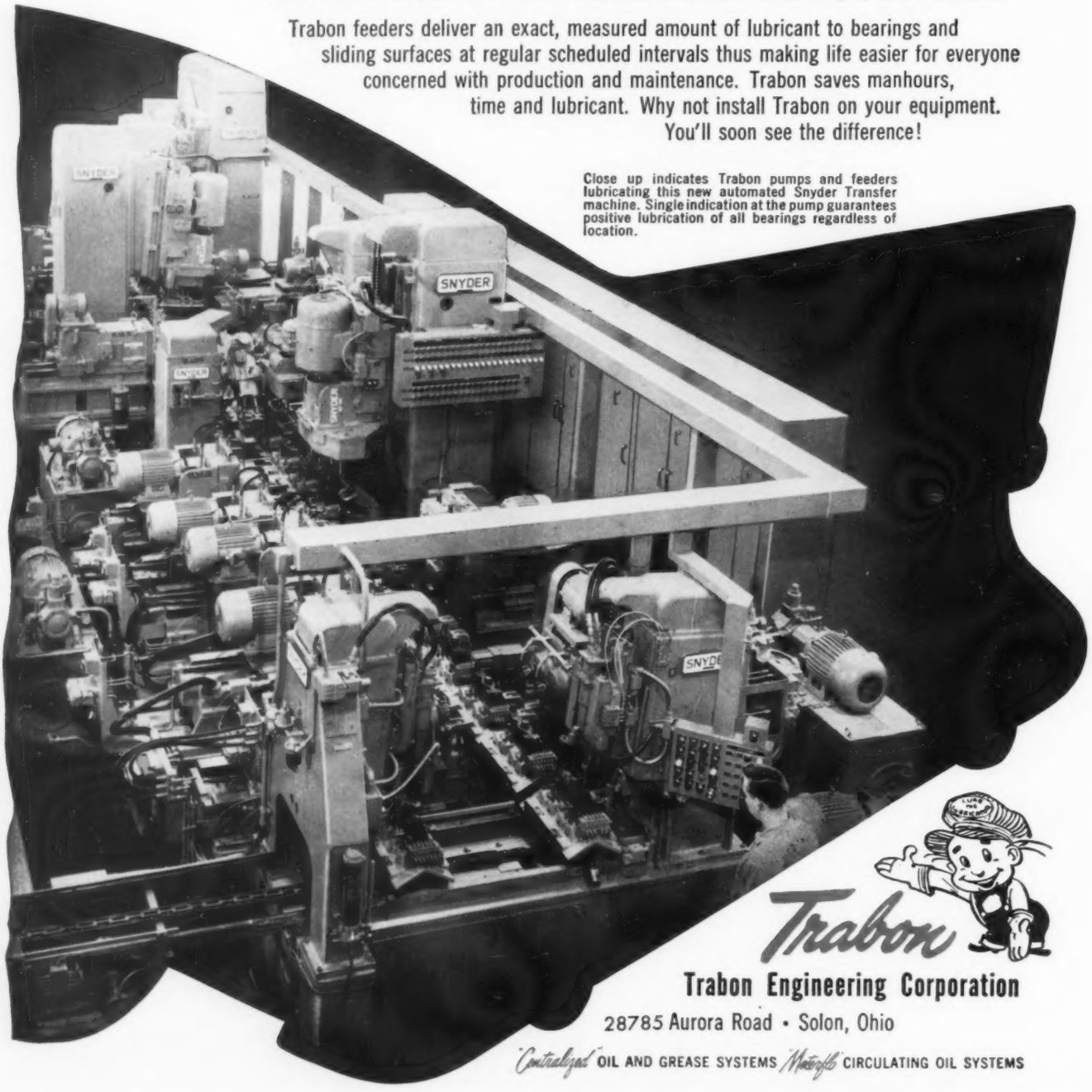
it processes automobile parts 24 ways—and relies on Trabon

Trabon on mammoth transfer machine lubricates 3,504 separate operations per hour

Sixty feet and 26-stations long is this new Snyder transfer machine. It mills, threads, drills, reams — in fact, performs 24 separate operations in processing steering knuckles for an automobile manufacturer. To lubricate this automated giant by hand would be an impossible job. That's why the manufacturer of this transfer machine had Trabon Automatic Centralized Lubricating Systems installed.

Trabon feeders deliver an exact, measured amount of lubricant to bearings and sliding surfaces at regular scheduled intervals thus making life easier for everyone concerned with production and maintenance. Trabon saves manhours, time and lubricant. Why not install Trabon on your equipment. You'll soon see the difference!



Close up indicates Trabon pumps and feeders lubricating this new automated Snyder Transfer machine. Single indication at the pump guarantees positive lubrication of all bearings regardless of location.

Trabon

Trabon Engineering Corporation

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Equipment News...

CIRCUIT BREAKER

Δ A new line of low voltage power circuit breakers with major design advances has been announced by General Electric Co.'s low voltage switchgear department. The new breakers are the AK-2-15 and the AK-2-25, available in frame sizes of 225 and 600 amperes.

Principle design advancement is a spring operated closing mechanism for both manual and electrical breakers. This closing device, which has been available in the larger AK breakers for five years, provides "stored energy" closing of breaker contacts at a speed independent of the operator.

On electrical breakers, closing is provided even though control power should be lost during the closing action. As a result, the mechanism prolongs contact life, reduces maintenance, increases safety and broadens applicability of the breaker particularly in the field of motor starting. It also eliminates many hazards of "slow make" closing where it was possible to severely damage a breaker when closing against a fault.

Unit mechanism construction of the new AK-2 breakers greatly facilitates field conversion from manual to electric operation.

The over-all design simplification of the breakers not only improves their appearance but makes maintenance much easier. For example, the overload trip devices are readily accessible and can be removed from the front of the breaker. Trip units are interchangeable for all ratings 1600 amps and below.

The new breakers are the same physical size as the previous AK-1 models and are easily interchangeable in existing cubicles and enclosures.

STOPPER UNIT

Δ A new emergency stopper closing unit, recently introduced by Blaw-Knox Co., is now being offered as optional equipment for the Autopour, a device introduced in 1952 by Blaw-Knox, which makes it possible to teem ingots from a safe, remote location.

This standard unit, without optional emergency equipment, employs hydraulic power to actuate the stopper. However, should electrical service fail or be cut at the central switches, the operator must convert to manual.

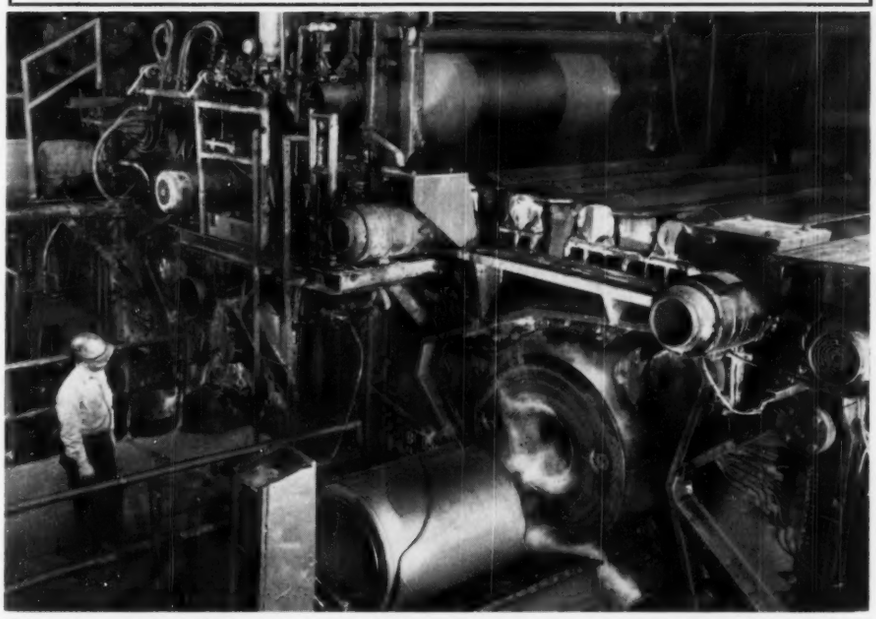
With the new unit a reserve of hydraulic power is automatically stored. This power is sufficient to close a stopper, terminating the pour, at any time after a power failure has occurred.

This is how the new unit works. During normal operation, oil stores in an accumulator as pressure in the hydraulic system builds up. While power is on, the oil is held by valves in the accumulator, regardless of number of times the stopper rigging may be actuated.

Should power fail, the operator switches to manual. By pulling a chain attached to the unit, valves are opened and the stopper is closed by hydraulic action. At no time is it necessary for the operator to approach the ladle from which pouring is taking place.

The manually operated valve can be mounted on the crane with a chain provided for operating the valve by the crane operator or from the pouring platform.

REBUILT DOWNCOILERS OPERATING FOR J&L



When it was found that the mandrels and mandrel drives of worn downcoilers on this hot strip mill at Jones & Laughlin Steel Corp.'s Pittsburgh works were still perfectly good, the Rolling Mill Division of the E. W. Bliss Co. rebuilt the downcoilers around them. Rebuilt components include housings, blocker rolls, stripper mechanisms, roller tables, guides and pinch roll units. They can handle 15,000-lb coils up to 90 in. wide.

MAGNETIC RUBBER

Δ Denmag, produced by Denman Rubber Mfg. Co. and just introduced by The Herr Equipment Corp. is a "magnetic rubber" that acts like a magnet, and may open up a whole new area of new applications, new economies, new thinking and new ways to cut costs in handling ferrous materials and parts in the producing, processing and fabricating industries.

Denmag is produced by compounding neoprene or other rubber and plastic substances with various permanent magnetic materials of small particle size. It is ready for wide application and offers various advantages:

1. Low cost.

DURALOY

25-20 Casting with Welded Assembly

This is a separator destined for a reaction process. It is typical of the kind of work we do in the high alloy casting field. In the 25 Cr-20 Ni range it is alloyed to withstand both corrosion and heat. Assembled, its weight runs some 2000 pounds. It was inspected and tested under very rigid ASME Code requirements.

The production of chrome iron and chrome nickel castings has been our sole business since 1922. We added centrifugal castings to our service in 1933 and shell molded castings in 1955. Our metallurgists have extensive knowledge of the many operations requiring high temperature and corrosion resistant castings. Perhaps this experience would be helpful to you if you are confronted with a specific problem and wish to determine the best alloying combination for your required castings. We can be helpful, too, in designing the unit, contributing our knowledge of strength and stresses in castings.

The DURALOY Company
OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
ATLANTA OFFICE: 76—4th Street, N.W.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.

2. Easy fabrication into different shapes.

3. Can be compounded to produce either strong or weak magnetic fields.

4. The magnetism can be applied in a variety of patterns.

5. Unlike other permanent magnetic materials, Denmag provides a low density magnetic flux over a large area, rather than a high density magnetic flux concentrated in a limited area.

6. The rubber provides a soft surface, and avoids marring or scratching.

7. Denmag assures cheaper, less costly handling.

This new material has been applied in a new Herr automatic stacker and feeder. Equipped with Denmag rolls, this unit is able to stack or feed any ferrous piece from 12 in. x 12 in. up to 36 in. x 48 in. and up to 0.03 in. or more in thickness. It can handle square, rectangular, circular, oval, elliptical, trapezoidal or other odd-shaped pieces. There is no drag, and the unit does not employ pinch rolls; consequently it does not damage, scratch or mar the surface finish of the pieces handled.

A machine already in service is said to be operating at roll feeds of 150 fpm and is performing very satisfactorily handling laminations with only a 3-in. gap between the pieces.

LIMIT SWITCH

△ A new limit switch which operates without physical contact has been announced by EC&M Div. of Square D Co. Designed for mill duty applications where heavy impact and shock cause mechanical limit

switches to break down, the switch operates on the principle of a resonant circuit.

The switch consists of three parts—a magnetic vane which is attached to the moving portion of the machine; a reactor unit, mounted on the stationary portion of the machine; and a standard a-c

VICTOR R. BROWNING

Mill Type Cranes

TO SPECIFICATION...

Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

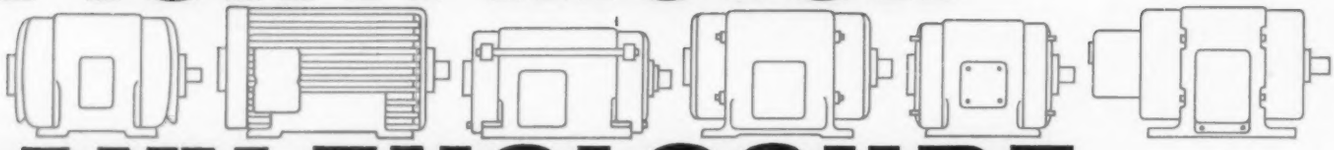
VICTOR R. BROWNING & COMPANY, Inc.

WILLOUGHBY (CLEVELAND), OHIO

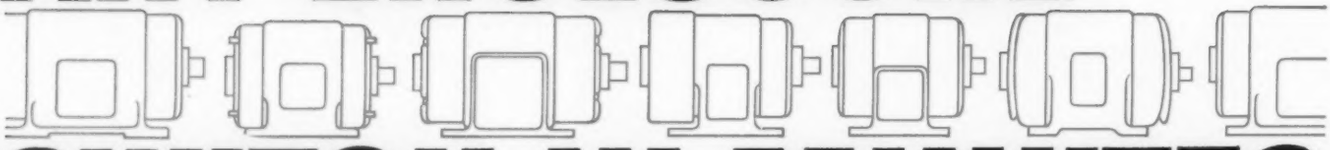
DESIGNERS AND BUILDERS OF ELECTRIC OVERHEAD TRAVELING CRANES AND HOISTS AND ELECTRIC REVOLVING CRANES

With a LINK-BELT Motogear—you can

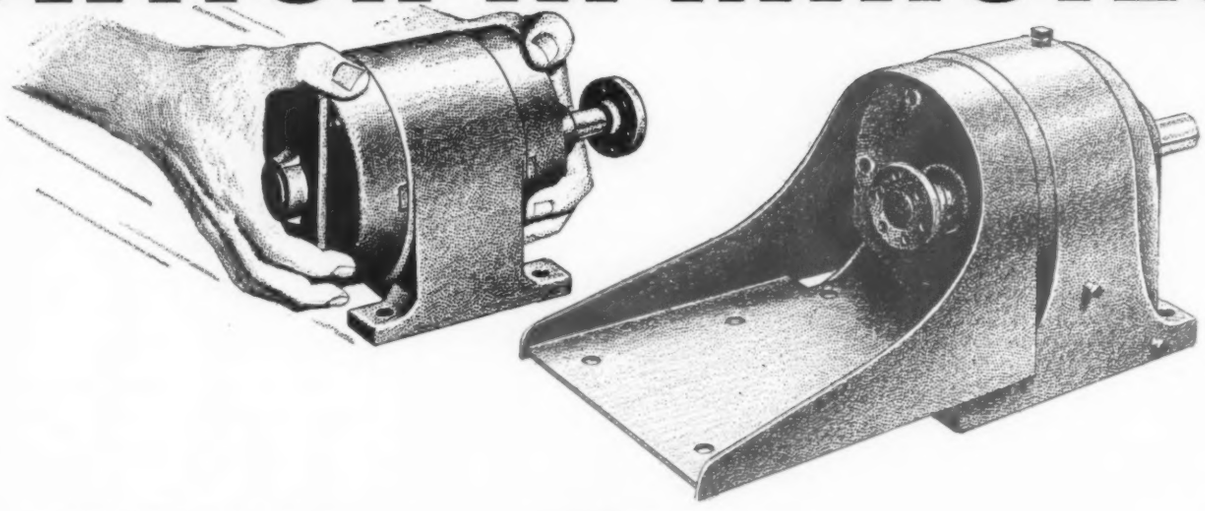
PICK A MOTOR



ANY ENCLOSURE



SWITCH IN MINUTES



DESIGNED for bracket-mounting foot-type motors of *any* manufacturer, Link-Belt Motogears radically slash delays in making motor replacements. Remove four bolts, disengage the coupling, re-assemble with another motor —and it's ready for work. No need to drain oil. And no re-alignment problems — the bracket assures accurate positioning of the motor.

Link-Belt Motogears are immediately available from nearby stocks, in sizes to 100 hp, output speeds from 280 down to 1.8 rpm. Call your Link-Belt office or authorized stock-carrying distributor. Refer to the yellow pages of your local telephone directory under the heading "Speed Reducers."

ASK FOR BOOK 2447 — contains features and data on Link-Belt Motogears. Also covers Gearmotors — with flange-mounted NEMA motors—and Electrofluid Motogears with *"Cushion Action."*

LINK-BELT

SPEED REDUCERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,788

TONGS

Nonautomatic tongs for lifting beams have been added to the stock items manufactured by Heppenstall Co. They are available in 3000-lb and 6000-lb capacities. Rounded ends of the tongs enable the jaws to slide over the flange of a beam, but when the tongs are lifted, the jaws close on the beam, supporting it firmly both from the sides and under the flange. The tongs are intended primarily for applications where the amount of lifting is limited and inexpensive tongs are adequate. The 3000-lb capacity tongs have a maximum opening of 10 in. and a minimum opening of 5½ in. The 6000-lb capacity tongs have a maximum opening of 13¾ in. and a minimum opening of 8¼ in.

▲

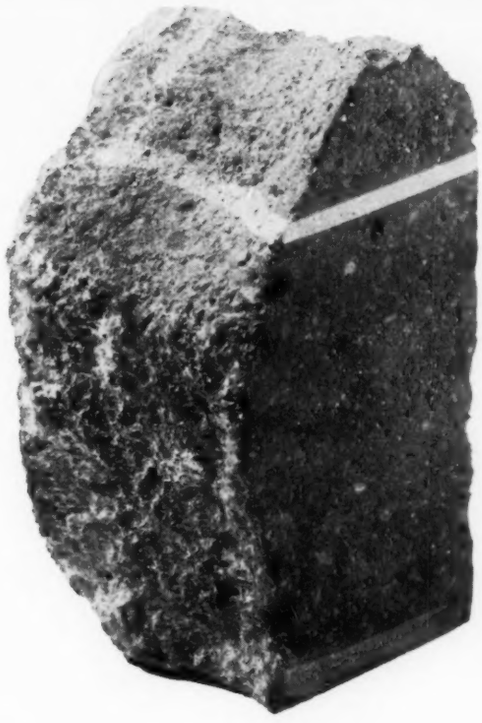
relay which opens or closes the circuit.

The action of the magnetic vane passing over the reactor actuates the relay. High sensitivity permits the switch to function when the vane is within ⅞ in. of the reactor, and operation is not affected by voltage variations up to ±10 per cent. Because no vacuum tubes are used, the switch can operate in the same high temperatures as a mechanical limit switch.

MAGNET PULLEY

△ A new magnetic pulley design is announced by Stearns Magnetic Products. Indox V ceramic permanent magnets energize the new pulley, producing a powerful magnetic field that effectively removes troublesome tramp iron from fast-moving conveyor burdens. The pulley is reported to equal the perform-

BONDING STRENGTH UNMATCHED!



Here's an unretouched photo of two pieces of carbon block joined with a weld-tight Super #3000 bond (horizontal white line on upper portion of sample). The sample was removed from one of the blast furnaces at a large steel works.

Considering carbon block's lack of porosity, high density and dusting properties, this powerful Super #3000 bond is nothing short of amazing.

More and more plants are discovering that no other refractory bonding mortar can match it!

REFRACTORY & INSULATION CORP.

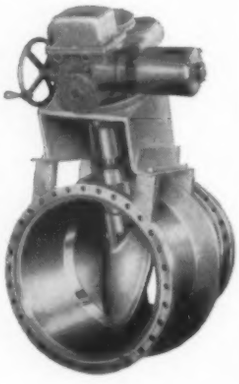
R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS
136 WALL STREET • NEW YORK 5, N. Y.

Your plant needs

ROCKWELL VALVES *like these*

"Kwikleen" slide valve for powdered coal, granular materials, flue gases with high solids content, etc.; solids accumulations easily cleaned out by removing bottom plate.



"Stress-seal" butterfly valve for tight shut-off of hot, corrosive or dirty gases to 1300° F. and higher, at 200 p.s.i. Alloy stress band in valve body is inflated by external gas pressure to effect tight seal.

Butterfly valve with simplified bracket and linkage to air operator and valve disc positioner; provides maximum adjustment, minimizes friction, eliminates backlash, chatter and hunting, reduces power requirement in close control applications.

"Slim-Jim" wafer type butterfly valve for low pressure air, gas or liquids; low cost, light, simple, space-saving, easy to install.

What's your valve problem?

W. S. ROCKWELL COMPANY
2428 ELIOT STREET
FAIRFIELD, CONN.

ance of electromagnetic types, and is far superior to conventional permanent magnet models.

Secret of the pulley's performance is the radial pole design of the magnet assembly which boosts holding efficiency without the disadvantages of electrical power supply.

Series "410" permanent magnet pulleys—and the Series "710" for deeper conveyor burdens—are available in standard widths from 12 in. up, and in diameters of 12, 15, 18, 20 and 24 in. (larger sizes on request).

SUBMERSIBLE MOTORS

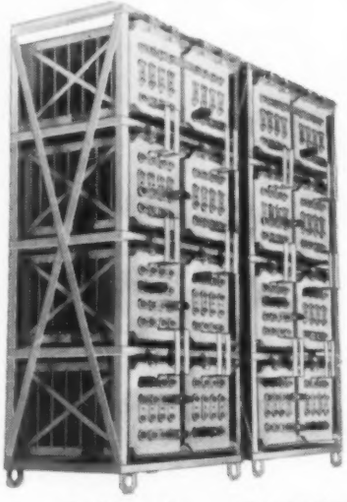
△ A complete line of submersible a-c electric motors for direct coupling to pumps which must operate continuously while submerged in oil, water or liquid chemicals has been introduced by Reliance Electric and Engineering Co.

The polyphase, single-voltage submersible motors are available in sizes from ¾ through 15 hp. The special universal mounting flange is designed for direct connection to most standard pumps; modifications can be made to meet special dimensional requirements.

The motor base is precision-machined for true concentricity of shaft providing easy, vibrationless close-coupling to the pump impeller with no painstaking alinement; the motor

shaft serves as the pump shaft. The pump-and-motor assembly can be lowered into mounting position and attached as a single unit. Integrally cast rings at the top edge of the frame permit convenient, balanced handling.

Rated at 55 C temperature rise for 30-min duty in 40 C air, and for



Don't Forget
TO CHECK the
MODERN
Resistor
on Your Next Revamp

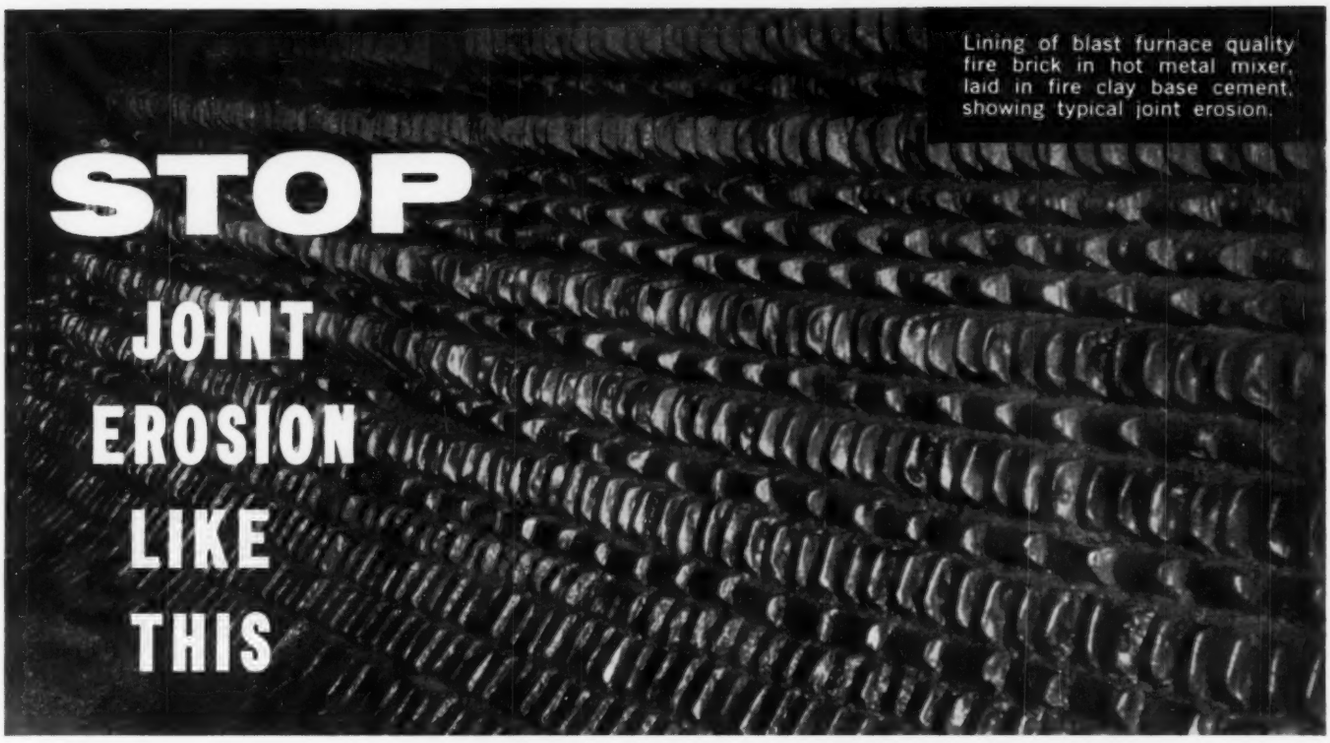
It's the GUYAN RESISTOR!

COMPLETELY assembled Racked Resistors with all interconnecting bus bars and terminal lugs installed. Custom designed for your individual conditions.

For your *heavy service* applications we offer Helical Coil construction to end warping and buckling burnouts. *One installation proves our modern design is superior.* Write for details.

GUYAN MACHINERY CO.
LOGAN, W. VA.

Guyan
RESISTORS



Lining of blast furnace quality fire brick in hot metal mixer, laid in fire clay base cement, showing typical joint erosion.

WITH TASIL

Super-Refractory Cements

Experience has shown that the failure of refractory linings in most types of industrial furnaces usually begins at the joints in the brick work. TASIL (Taylor Sillimanite) Super-Refractory Cements are outstanding for high refractoriness, negligible shrinkage at high temperatures, and resistance to slagging and abrasion. Thus the tight, weld-like joints formed by TASIL Cements prevent joint erosion and rapid failure of the furnace lining.

TASIL Cements are recommended for bonding sillimanite or mullite, high-alumina, kaolin-type and super-duty fire brick and special shapes in any high-temperature furnace. They are especially recommended for bonding linings in:

Hot Metal Cars and Mixers
Blast Furnaces
Blast Furnace Stoves
Heating Furnaces of all types
Heat-Treating Furnaces
Salem Continuous Tube Furnaces
Electric Furnace Roofs and Sidewalls when built of Alumina-Silica Brick
Detroit Electric Furnaces
Forge Furnaces

Also excellent as a protective coating on walls and arches built of insulating fire brick

Let the Taylor field engineer in your district give you full details, or write for your copy of TASIL Cements Bulletin No. 314.

Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
Hamilton and Montreal

The **CHAS. TAYLOR SONS Co.**
A SUBSIDIARY OF NATIONAL LEAD COMPANY

REG. U. S. PAT. OFF.

REFRACTORIES SINCE 1864 • CINCINNATI • OHIO • U. S. A.

continuous duty in 40 C liquid, the new pressure-proof motors are oil-filled to give long, trouble-free performance when immersed at any depth.

Exclusive Reliance "Liqui-Seal" construction seals in the motor oil and seals out external contaminants. A neoprene diaphragm in the motor base flexes slightly to offset minute differences between internal and external pressures, relieving pressure build-up around the positive shaft seal or o-ring seal between the motor frame and mounting bracket.

The single-unit, ribbed cast-iron motor frame is completely corrosion-proof. Heavily plated bolts and stainless steel nameplate are impervious to all types of corrosive liquids.

FORK TRUCK

△ An entirely new line of electric powered fork trucks has been announced by the Industrial Truck Div. of Clark Equipment Co.

Named the "Clarklift Electric," the new trucks are an addition to the line of gas-powered fork trucks Clark introduced two years ago, and contain many of the design and operating features of the gas models. Major components of electric and gas models of similar capacities are interchangeable.

The first model of 2000-lb capacity, is now in production. Additional models of heavier capacity are being scheduled.

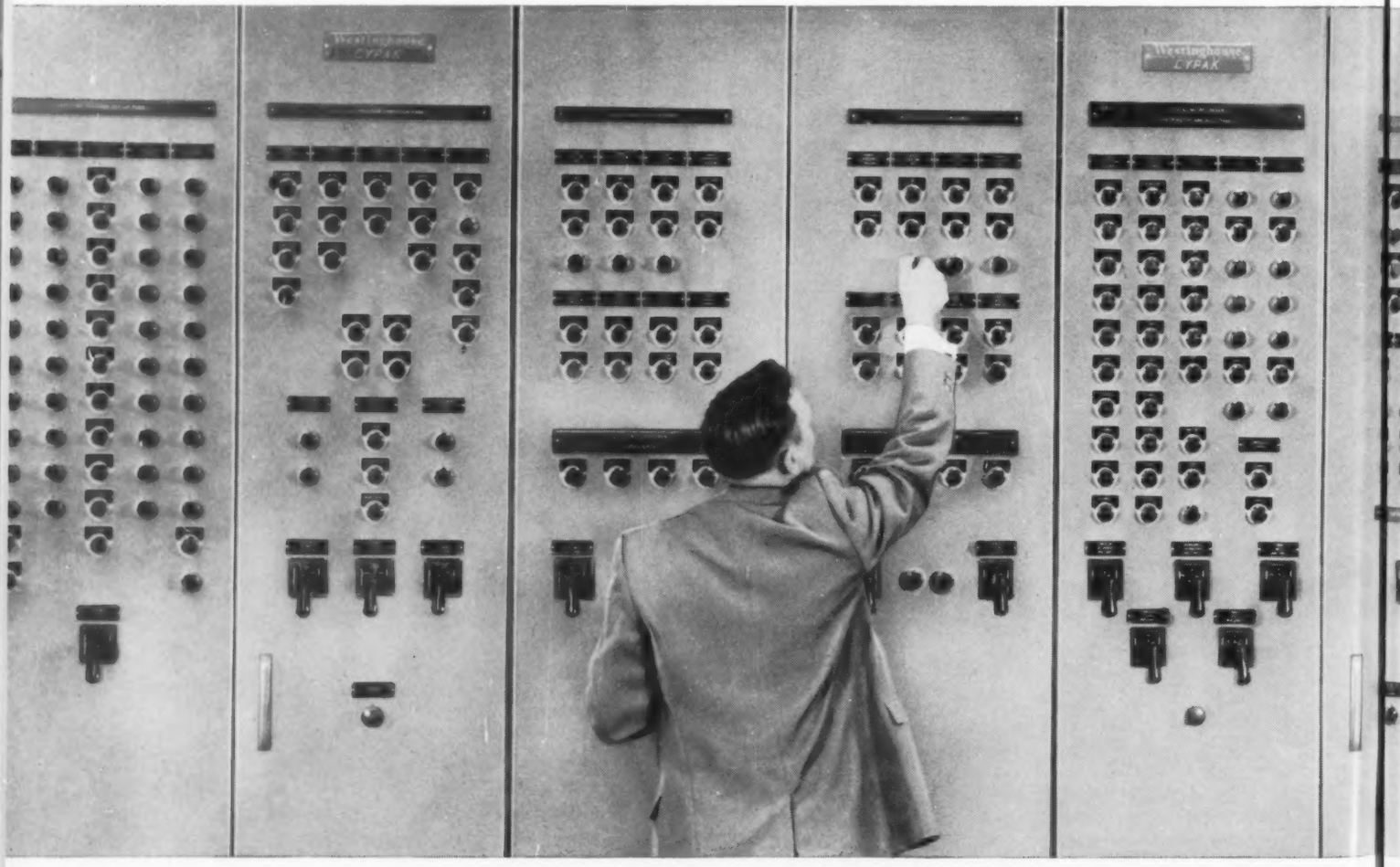
A major performance advantage of the new machine stems from the use of a new type of "carbon pile" drive control which provides constantly smooth acceleration from a standstill to full maximum speed and permits full control of "inching" during delicate stacking operations. Controls are automatically timed so that maximum acceleration is provided without excessive current.

Much of the design effort on the unit went into maintenance and accessibility features. The pump motor is mounted on the left side of the frame, accessible through a hinged side panel. By removal of two nuts the drive motor swings down from its operating position for maintenance. The contactor panel is located in the counterweight, protected by a steel plate which is removed easily for contactor maintenance. Batteries can be removed from either side or the top by removing a one-piece, light weight Fiberglas hood which is a nonconductor and is impervious to battery acid. Self-adjusting brake shoes eliminate need for brake adjustment during life of the lining.

The truck has rear steer wheels the same diameter as front drive wheels to give easier steering and more comfortable ride. A long wheelbase with a short over-all length plus weight distribution which puts almost half of the weight on the front axle gives the truck positive tractive power. The 2000-lb model will climb a ten per cent grade with full load.

Interchangeable parts include the steer axle, drive axle ends (including brakes, wheels and tires), cowl, control lever mechanisms, adjustable seat and a number of minor parts.

The upright mechanism, also interchangeable, is the same used on gas models. Roller mounted, the uprights are nested to increase vision. Inner uprights are "I" beams rather



than channel sections for greater strength and rigidity. Side thrust rollers prevent separation of uprights and reduce lateral tipping of the fork carriage when a load is carried off-center. Lift chains are placed so as not to interfere with visibility.

The hydraulic system contains a "tilt lock" valve which gives positive control of the uprights at all times. A flow regulator in the lift cylinder controls lowering speed of forks.

The 2000-lb capacity truck now in production, called the EC-20, will travel up to 6.5 mphr both forward and reverse and has a lift speed, loaded, of 50 fpm. It has a turning radius of 62 in., a length of 67¼ in., a width of 34½ in. and a 44 in. wheelbase. It is available with either a standard or a "Hi-Lo" upright.

A series wound, 30 to 36-volt high torque drive motor features dual field for high efficiency at reduced speeds.

The EC-20's upright will tilt 12 degrees backward and 6 degrees forward to facilitate horizontal load pickup while the truck is on an incline. Forks can be adjusted laterally up to 30 in., and all models of the line have identical fork mounting dimensions so that forks and attachments can be interchanged.

"O" RING KIT

Δ A new and efficient approach to the industrial maintenance man's problem of being able to have on hand at all times "O" rings in

sizes usually required for emergency or for planned replacement schedules, is being offered by Bearings, Inc.

The Universal Select-O-Ring Kit No. 2 contains 180 "O" rings in sizes from 1 to 25. These sizes, surveys show, are used on 70 per cent of industrial equipment incorporating "O" rings as sealing members.

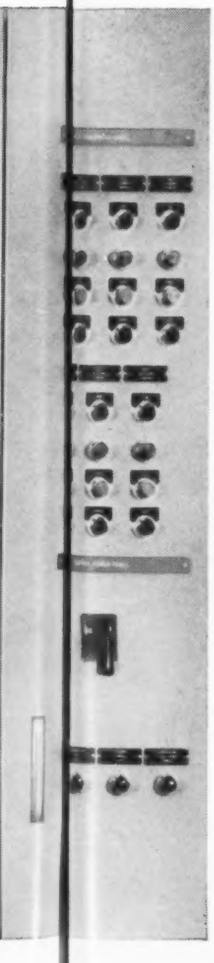
The patented, shock-resistant, plastic case in which the rings are packed serves also as a gaging or measuring tool. The rings are packed on pegs that duplicate the shafts on which the rings are to be used.

A small gage is molded into the side of the kit which gives instant cross section measurement. By doubling the cross section thickness plus the known I.D., as shown on the peg, the result is the O.D. of the "O" Ring.

Interchange information of all leading producers of "O" rings is supplied with each kit.

PLUGS—RECEPTACLES

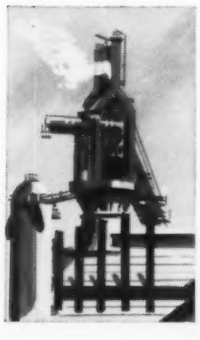
Δ A new line of plugs and receptacles designed to meet severe industrial environmental conditions has been announced by the Pyle-National Co. They are identified as Pyle-star-line circuit breaking series



CYPAK blast furnace programmer . . . another big step toward steel mill automation

Blast furnace operation can now be completed with pushbuttons, including complete control of sequencing and automatic charging, through the use of Westinghouse CYPAK* Automatic Blast Furnace Programming.

The element of human error has been completely removed for better product composition and quality. With CYPAK, blast furnace operation can be programmed and then allowed to operate automatically, with full protection against error or misjudgment.

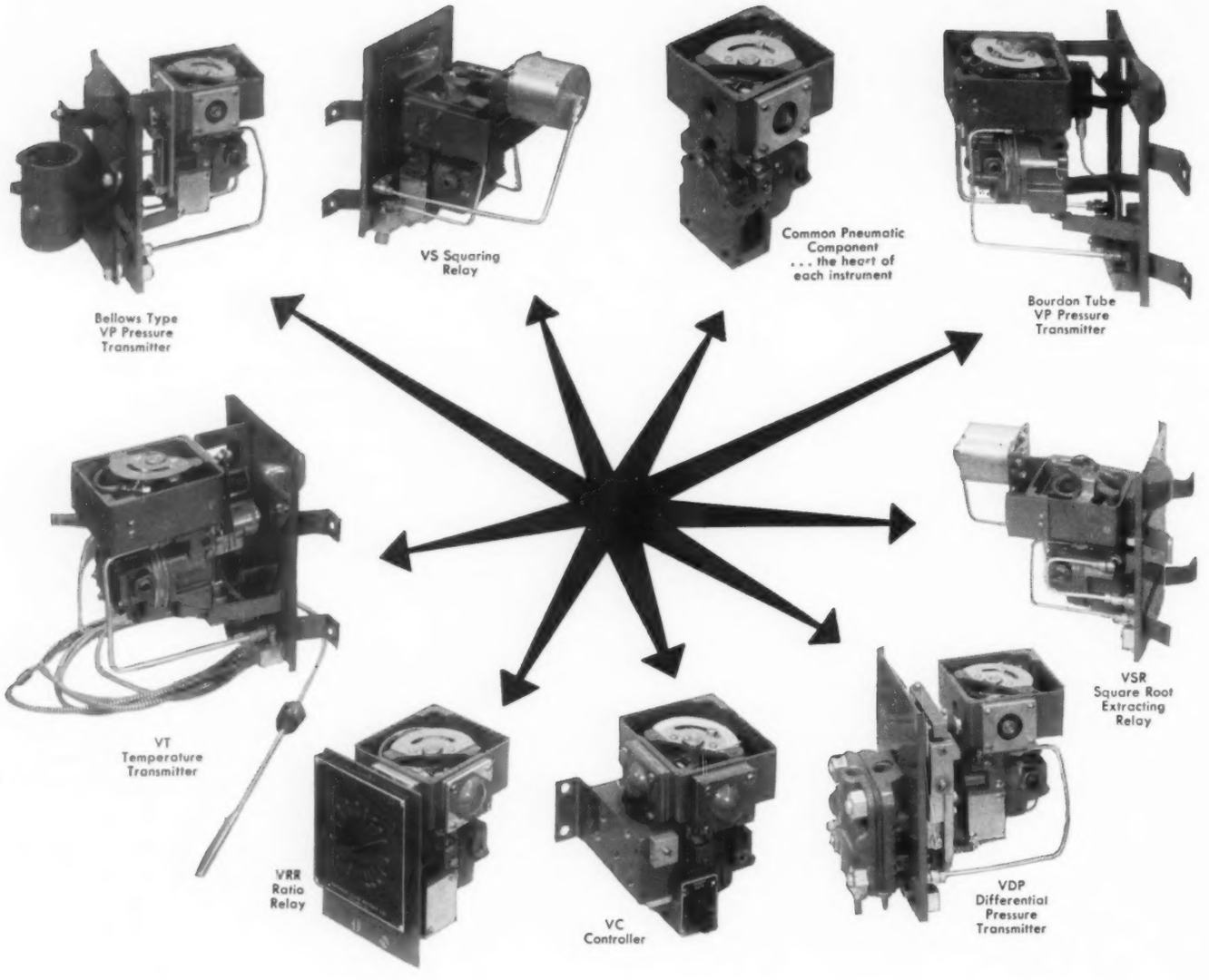


For complete information on this system and other Westinghouse control systems, call your local representative, or write: Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

*Trade-Mark J-22110

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse



It's YOUR move—in ANY direction—with

Republic's New Family of Null-Balance-Vector Instruments

Here are only a few of Republic's new line of pneumatic instruments. Their sensitive, extremely accurate components are both compact and interchangeable. Their versatility is phenomenal. Consider: the Vector Series components in *each* of these instruments can be moved and *recombined in infinite variety*. They form temperature transmitters with 10-to-1 range adjustment . . . pressure transmitters of ±0.5% accuracy . . . differential pressure transmitters with 20-to-1 range adjustment . . . controllers which feature repeatable re-set rate, less than 0.05% dead band and proportional band adjustment from 2 to 500%.

The span of each instrument can be varied at will; only a screwdriver and a reference are necessary—zero need not be re-set. Republic's Null-Balance-Vector design permits full-range operation with virtually no parts motion—and virtually no wear.

This new family of pneumatic instruments was developed in a coordinated program to use the greatest possible number of common components. Because these can be interchanged, even among instruments performing entirely different functions, training and spare parts problems are greatly simplified. The versatility of Republic components is at once a challenge and an answer to imaginative engineers. A few minutes of discussion on this subject could be well worthwhile . . . and a call to your nearest Republic Sales Office will set it up at your convenience.

For detailed, descriptive folios write

REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

"C" connectors and are listed by the Underwriters' Laboratories, Inc., for interrupting circuits in N.E.C., ampere ratings of 30, 60, 100 and 200 amperes, 600 volt, alternating current.

All types have a double lead plug coupling thread for quick connect and disconnect action. Threaded housings can be furnished with dust cap or a hinged spring flap cover.

Complete interchangeability of components permits many assembly combinations including a wide choice of contact configuration inserts ranging from 4 to 100 poles for power, control and electronic circuits.

Circuit breaking types are furnished with solder well or pressure type (solderless) wire terminals. Taper well or crimp type contacts are available with other contact inserts. All contact inserts are reversible for male or female assembly.

Pressure proof silicone "sandwich" insulation construction, low weight, compact size and attractive styling are among the many outstanding features.

ROLL NECK SEAL

△ Syntron Co. announces a new mechanical roll neck seal for bearings on work and backup rolls in strip mills, tempering mills and other rolling mills.

The seal is 100 per cent self-contained—consists of two maintenance-free components which provide positive, two-way sealing to keep water out and lubricant in.

A flexible, specially compounded, long-wearing rubber element fastens to and revolves with the roll neck. This element seals against the burnished walls of its housing which is stationary in the roll neck bearings.

All sealing takes place within the seal itself—never causes expensive roll neck maintenance, because no part of the seal ever rubs or wears the roll neck.

Installation is quick and easy. Slips right into place, doesn't require roll neck or bearing modifications.

VERTICAL MASTER SWITCH

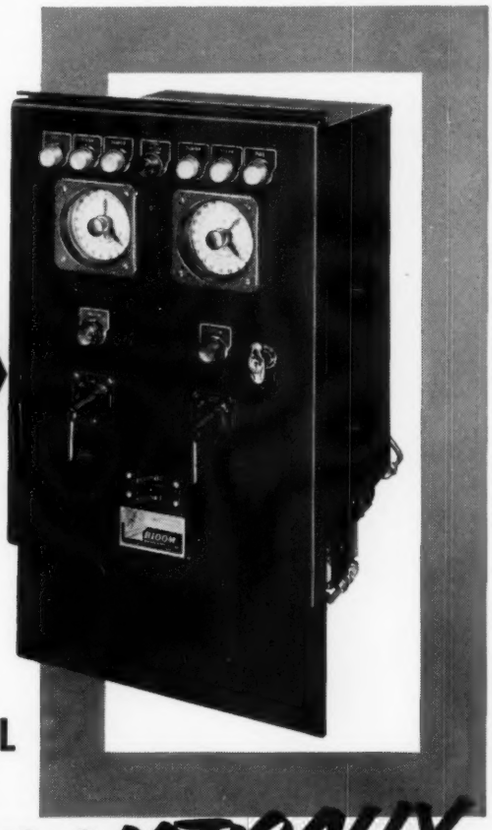
△ A small-size vertical master switch for heavy-duty applications has been developed by EC&M Div. of Square D Co. Offered in four sizes to accommodate maximums of 4, 9, 12 and 16 circuits, the new VM master switch is supplied for either right or left-hand operation. It is available with or without enclosure.

With mill-type construction throughout, the switch is designed for any desk-mounted mill or crane application where space is limited. Optional features include spring return to off point and pushbutton contact in handle.

OXYGEN CUTTING UNIT

△ Newly designed oxygen cutting machines will be sold and serviced on a national scale by American Messer Corp.

The BLOOM Time-Cycle Reversal Unit



assures FULL, FAST AND EFFICIENT REVERSAL OF REGENERATIVE FURNACES AUTOMATICALLY

This complete, compact, factory-tested unit provides a combination electric-pneumatic system for Open Hearth Furnace and Soaking Pit reversal. It eliminates reversal puffing and shortens reversal period. (10 to 15 seconds easily accomplished).

Shorter reversal cycle improves furnace life.

These units have been in continuous service for nine years. Trouble-free maintenance.

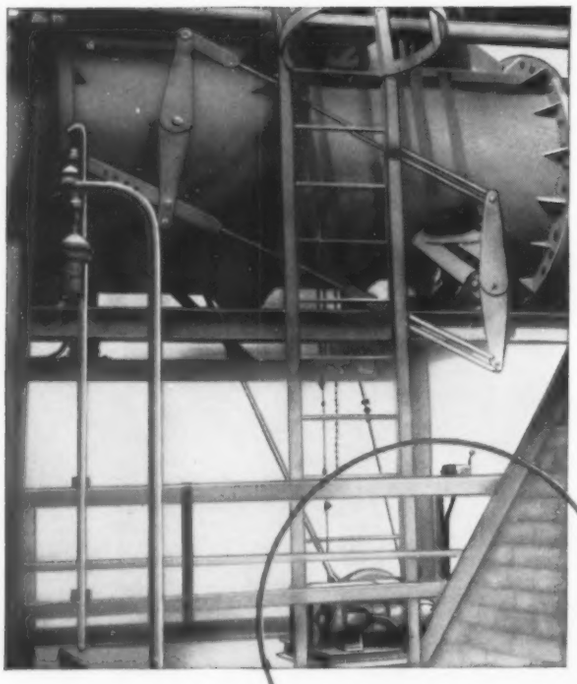
BLOOM ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 33, Pa.

WRITE or phone for complete information on the Bloom Time-Cycle Reversal Unit.

Freyn-Design MOTOR OPERATOR

For Any Blast Furnace Snort Valve

...Fast, Positive Power Operation!



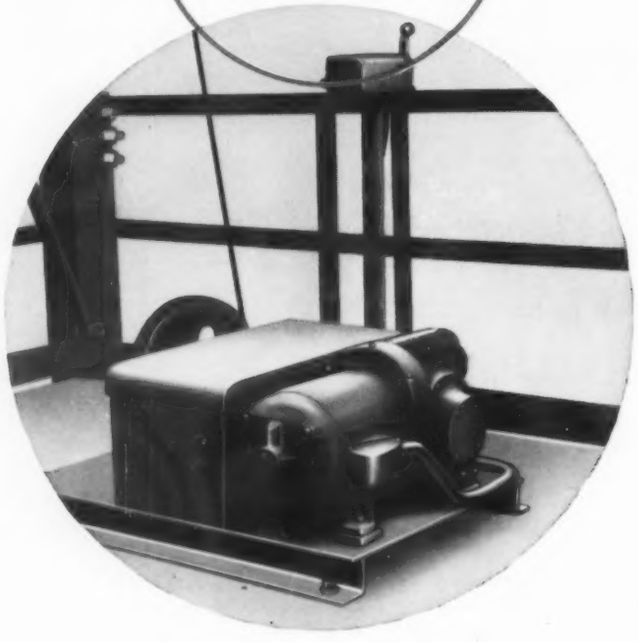
Located right at the snort valve, the Freyn-Design Motor Operator provides a direct mechanical drive between the snort valve operating shaft and the motor operator drive shaft. It is thereby not dependent on long cables extending from the cast floor handwheel.

A master switch for controlling the operator is located in the cast house. Additional switches can be easily installed, giving you the advantage of controlling the operator not only from the cast house, but also from *any* location desired.

In the event of electrical power failure, the motor drive automatically disconnects, permitting full use of the handwheel which is provided in the cast house for emergency manual operation.

There are seven installations of this type of Freyn equipment at three blast furnace plants—*and four of these installations were repeat orders!*

Write for booklet giving drawings and descriptive information, or consult with our engineers.



Top Photo: The snort valve at top responds quickly, is easier to control with the Freyn-Design Motor Operator shown at bottom.

Bottom Photo: Close-up of motor operator with one of several master switches (on top rail) in addition to the master switch in the cast house.

KOPPERS COMPANY, INC.
ENGINEERING AND CONSTRUCTION DIVISION
Pittsburgh 19, Pa.

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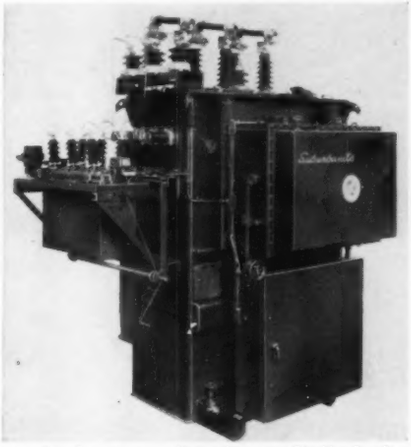

steel plant applications. Called the "suburbanite," to emphasize small town and rural area applications, the completely integrated substation is said to offer savings as high as 25 per cent in initial cost, compared with other types of substations.

The substation utilizes an automatic recloser rather than an oil or air circuit breaker. Other equipment includes metering devices, load tap changing equipment in the low voltage, high and low voltage arresters, and high voltage fuses. The company reports that the unit ordinarily is used with pole-mounted disconnect switches, thus providing a complete substation with a minimum of installed equipment.

Although generally recommended for applications through 2500 kva, "suburbanite" may be used for larger ratings within the capacity of reclosers. High voltages range from 15 through 69 kv, and low voltages from 2.4 through 15 kv.

Book Reviews

"Motion and Time Study" (fourth edition) by Ralph M. Barnes has recently been published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 665 pages, 6 x 9 in., is cloth bound and sells for $9.25. In this new, revised edition there is the same adherence to presenting the basic principles that underlie the successful application of motion and time study, each supplemented with illustrations and practical examples. Five new chapters have been added dealing with motion study, mechanization and automation; mechanized time study and electronic data processing; systems of

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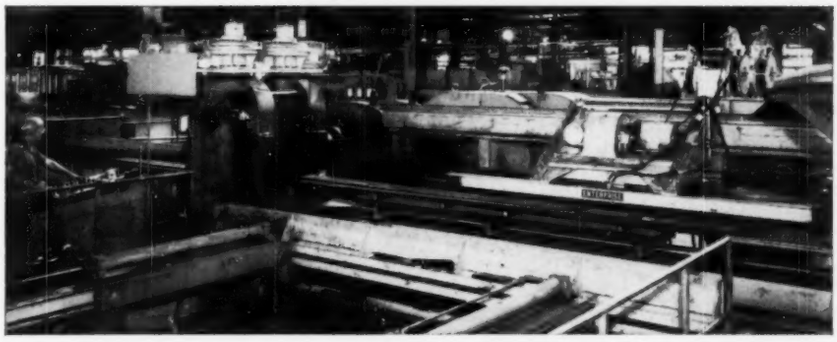

A new Enterprise plate handling system replaces a four-man hand-feed operation at the H. K. Porter Company, Inc. breakdown mill, Riverside-Alloy Metal Division, Riverside, N. J.

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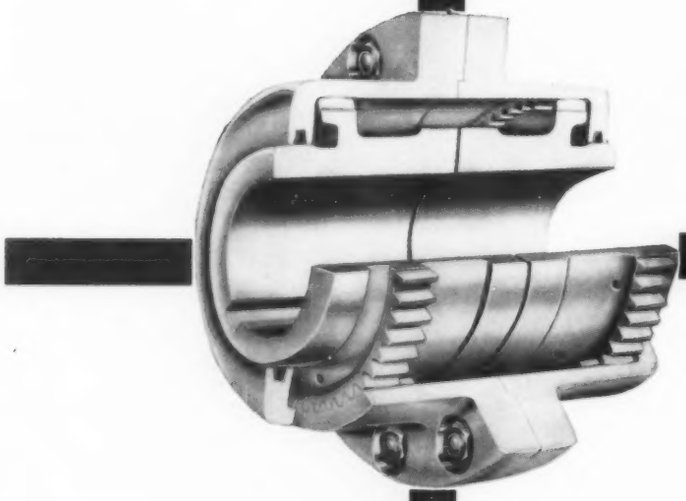

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motion-time data; work sampling; evaluating and controlling factors other than labor, and multifactor wage incentive plans. Also included are new material on developments in the industrial use of pulse rate of physical activity; an enlargement of the section on time study by new material on statistical procedures in time study and information on auditing of methods, time standards and wage incentive plans. All known systems of motion data are outlined and four of these systems are described in detail, including complete tables of motion-time data for each. Numerous photographs, charts, tables and diagrams are used to explain and supplement the text.

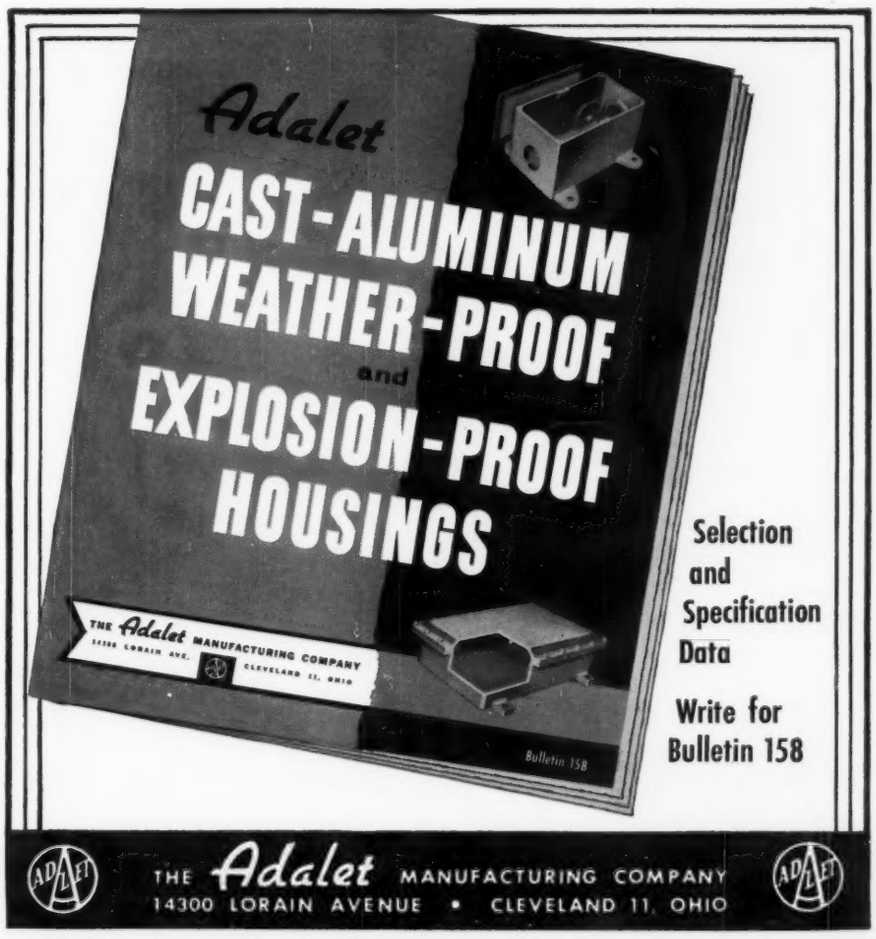
"NEMA Standards Publication for Secondary Unit Substations," 210, 1957, to 213, 1957, has been recently published by the National Electrical Manufacturers Assn., 155 East 44th Street, New York 17, N. Y. The book contains 49 pages, 8½ x 11 in., with heavy paper cover, and sells for $3.00. This publication contains practical information concerning the preferred arrangements, ratings, one-line diagrams and specifications for unit substations having a low-voltage rating of 1500 volts or below.

"Qualitative Testing and Inorganic Chemistry," by Joseph Nordman, has recently been published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 490 pages 6 x 9 in., is cloth bound, and sells for $6.25. The book is a full, rigorous treatment of qualitative analysis, up to date in theory, and with a distinctly modern, practical approach. The text, complete without the aid of an added problem book or lab manual, offers many excellent features which include: (1) numerous fairly involved problems in calculations actually worked out within the chapters, plus a large number of problems at the end of each chapter; (2) extensive practical applications of the subject to industrial chemistry, with a full chapter devoted to special experiments which illustrate such practical aspects as analytical chromatography, electrography, experimental determination of equilibrium constants, chemical microscopy, etc.; (3) twenty-four page chapter on chemistry and analysis in common alloys and matrixes of W, Mo, Ti, V, Zr, Be, U, Li; (4) thorough treatment of elementary chemical equilibrium; (5) chapter on organic analytical reagents; (6) explanation of experimental methods for determining the physical constants used in calculations; (7) review of equation writing, mathematical manipulations, and expression of solution concentrations; (8) sections on blow pipe analysis, dry fusions, bead and flame tests. Throughout the text thioacetamide has been used instead of H_2S. Since its purchase price is still high, a method for preparation has been provided.

"The Making, Shaping, and Treating of Steel," seventh edition, has recently been published by the United States Steel Corp. The book contains 1048 pages, 8 x 11 in., is cloth bound, and sells for $7.50 (students in colleges, $5) and is available from the U. S. Steel Corp., 525 William Penn Place, Pittsburgh 30, Pa. This is a useful compilation of facts dealing with past and present practices in the iron and steel industry. Over 200 individuals took part in the preparation, etc., of this edition. The information has been critically reviewed and edited, and extensively rewritten to incorporate the latest knowledge in the field. The scope of the work is broad covering from iron in antiquity to the latest methods of producing steel. There are 50 chapters in the book, covering all phases of steel plant operations. Photographs, line drawings, sketches, graphs, charts and tables are used effusively to explain and supplement the text. It is the outstanding, and most complete and authoritative book in its field.

"The Heating Ventilating Air Conditioning Guide for 1958," 36th edition, has recently been published by the American Society of Heating and Air-Conditioning Engineers, 62 Worth Street, New York 13, N. Y. Co-ordination of the project was under the direction of the Guide Committee of the Society. The book contains 1775 pages, 6 x 9 in., is cloth bound, and sells for $12. The book is comprised of a technical data section and a catalog data section. The general format of the text

(*Please turn to page 222*)



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Book Reviews

(*Continued from page 219*)

of the technical data section is in seven sections as in earlier editions: fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels, systems and equipment, special systems, and instruments and codes. The entire technical data section was carefully studied and appraised to make sure the information is abreast of current practice and presented in a beneficial way. Revisions and additions include: addition of both a description and a design method for high velocity air duct systems; an enlarged section on the heat pump; new information on exhaust hood performance and design for hot and cold processes; a simplified presentation of industrial drying principles, calculations and system design; extension of data on heavy fuel oils and their use, with preheating, in automatic fuel burning equipment; new data on heat gain through glass block used in skylights, requirements for shading glass and basic principles involved in calculating heat flow through glass areas; there is a general revision of the chapter on radiators, convectors, baseboard and finned-tube units and addition of new data on their ratings, and performance; a revision of ranges of capacity for electrical heating units and a method of determining operating cost for these units; an enlarged section on performance and testing of air cleaners; extension of list of allowable concentrations of air contaminants; an increased number of codes and standards of interest to users. The catalog data section follows the pattern of former editions, but the equipment data have been brought up to date. The pages contain both descriptive and performance information as well as application data. For convenient reference both sections are carefully indexed throughout. The ASHAE psychrometric chart, 24 x 32 in., is included in a pocket in the back cover.

"Radioisotopes—A New Tool for Industry," by Sidney Jefferson, has recently been published by the Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. The book contains 110 pages, 7½ x 5 in., is cloth bound, and sells for $4.75. This book gives an insight into the many and varied ways in which industry has benefited and can benefit from the use of radioactive materials. Industrial applications, radioisotopes and the advantages derived therefrom are examined and explained. One example is the detection of leaks in tanks and pipes; trenches for pipes laid under the ground can now be filled in immediately and tested afterward for leaks by a method of radioactivity—so dispensing with the need for keeping the trenches open until a pressure test can be made. Another application is checking the thoroughness of mixing, hitherto a lengthy and slow process. Now by making the additive radioactive, results can be achieved much more quickly and cheaply. In addition, the elementary fundamentals of radioactivity, covering atomic structure, atomic energy and atomic piles, transmission and detection of the radiations, health precautions essential to those working in this field are covered. Photographs, line drawings, and sketches supplement the text.

"The Metallurgy of Vanadium," by William Rostoker, has been published recently by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 185 pages, 6 x 9 in., is cloth bound, and sells for $8.50. Vanadium can be produced in a state of purity that will admit of formability and can serve as an alloy base. However, the state of knowledge of alloying and physical and mechanical properties of vanadium is far from complete. This book is a progress report offering a full discussion of the state of the art at the present time, providing a comprehensive treatment of the extraction, properties and processing of the metal. Photographs, tables, charts, graphs are used extensively throughout the book to explain and supplement the text.

"History of the British Iron and Steel Industry—From C 450BC to AD 1775," by H. R. Schubert, has been published recently and is available from The Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. The book contains 445 pages, 6 x 9 in., is cloth bound, and sells for $12. This is the first comprehensive history of British iron and steelmaking and covers the period 450 BC to AD 1775, from pre-historic times to the introduction of steam power. This period is essentially marked by the use of charcoal as fuel. The evolution of furnace, mechanical devices and methods are based upon much new documentary evidence. The book deals lucidly with many fascinating technical and archaeological problems. Many interesting photographs, line drawings, etc., add flavor to the history.

"Stainless Steel Fabrication," a new 386-page book on the fabrication of stainless steel is now being distributed by Allegheny Ludlum Steel Corp. It has more than 140 photographs, 120 charts and graphs, and about 200 special diagrams on the making of this versatile metal into usable products. In addition, there is a complete section of almost 30 special reference tables on stainless steels. A detailed index for cross reference purposes is included in the hard-backed book. The book has nine chapters, and goes into detail on every common method and practice for the successful fabrication of this metal. There are such chapter headings as: cutting operations, joining operations, cold forming operations, hot forming operations, machining operations, heat-treating operations, surface-treating operations and others. A copy of the book can be had by writing on company letterhead to the Advertising Dept., Allegheny Ludlum Steel Corp., Oliver Building, Pittsburgh 22, Pa.

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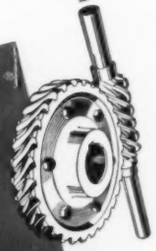

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